MEMOIRS of the NATIONAL MUSEUM of VICTORIA

NUMBER

28

Melbourne, Australia

1968

Registered at the G.P.O., Melbourne, for transmission by post as a periodical

MEMOIRS

of the

NATIONAL MUSEUM OF VICTORIA

MELBOURNE AUSTRALIA

No. 28

PUBLISHED BY ORDER OF THE TRUSTEES
11 MARCH 1968

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A NEW SPECIES OF AUSTRALIAN GRASS-WREN

By Norman J. Favaloro
Honorary Associate in Ornithology
and Allan McEvey
Curator of Birds

Abstract

The current classification of Australian Grass-Wrens of the genus *Amytornis* is summarized and a new species *Amytornis barbatus* the Grey Grass Wren of the Bulloorine in north-west N.S.W. is described. Descriptions of the nest and eggs, and general field notes on the species, are included.

Introduction

The several *Amytornis* species have been aptly referred to as 'one of the few truly desert groups in the Australian avifauna' by Keast (1958, p. 33), who has also remarked 'The genus is particularly rich in distinctive isolated forms that, though they have never had their true status tested by contacting the parental stocks, are nevertheless so different that, if normal taxonomic procedure be applied, they must be regarded as species' (ibid.).

Taxonomy

The most recent attempts to clarify the taxonomic relationships of the group have been those of Keast (1958, 1961), Mees (1961) and Condon (1951, 1962) and the reader is referred to these publications for taxonomic details. Acquaintance with this literature will reveal that, as Keast explains, the genus *Amytornis* falls '. . . . . into two species groups, the *striatus* group, which has a rich and somewhat complicated colour pattern, and the *textilis* group, with a simple colour pattern. Behavioural differences between typical species in the two groups include a "sweet, rippling song" in *A. striatus* and the absence of song in *A. textilis*' (Keast 1958).

The distribution of the species and races as accepted by Keast are shown diagrammatically in fig. 1. The species comprise: (a) *striatus* group: *A. s. striatus, A. s. merrotsyi, A. s. oweni, A. s. whitei*, (*A. housei* of uncertain derivation), *A. woodwardi, A. dorotheae.* (b) *textilis* group: *A. t. textilis, A. t. macrourus, A. t. myall, A. t. everardi, A. t. purnelli, A. modestus modestus, A. m. inexpectatus, A. goyderi.* In connection with *A. modestus* Keast (1958) remarks 'Mr. N. Favaloro has informed the author that an *Amytornis*, presumably this species, occurs in the extensve cane-grass "triangle" to the south of Bulloo Lake, south-western Qld.'. Condon (1962) gives the range of *A. m. inexpectatus* as 'Extending from west and south of Lake Eyre, eastwards to SW. Queensland (Bulloo Lake), ...', presumably on the basis of Keast's information. Specimens recently collected in this region have proved to be a new and distinctive species now to be described.

Amytornis barbatus, new species

Type Locality: Teurika, north-west N.S.W. (Fig. 2).

Specimens: All from type locality and collected by N. J. Favaloro on July 7, 1967.

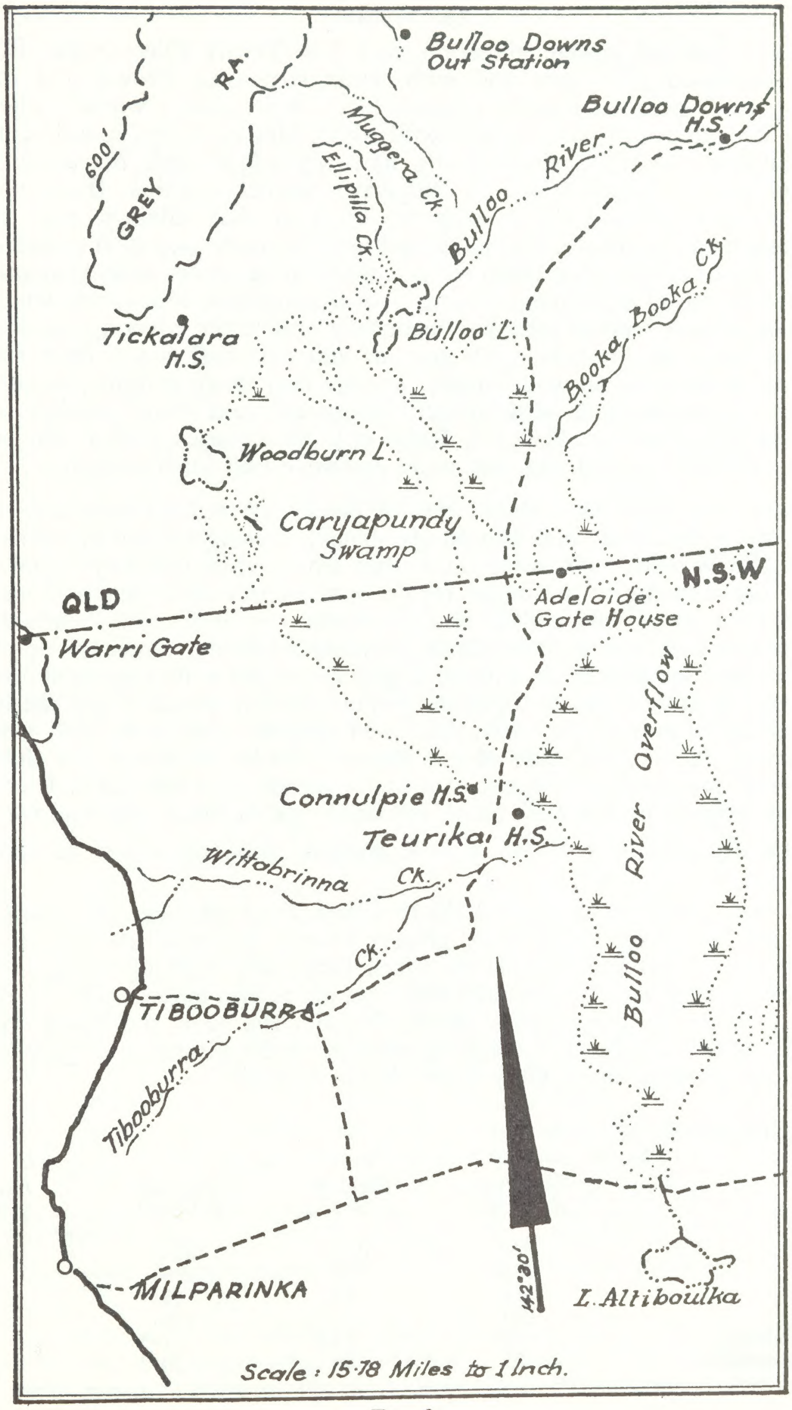
Bulloo Downs
Out Station
Bulloo Downs
H.S.
GREY
RA.
600'
Muggera Ck.
Ellipilla Ck.
Bulloo River
Tickalara
H.S.
Bulloo L.
Booka Booka Ck.
Woodburn L.
Caryapundy
Swamp
QLD
N.S.W
Adelaide
Gate House
Warri Gate
Overflow
Connulpie H.S.
Teurika H.S.
Wittabrinna Ck.
Bulloo River
Ck.
TIBOOBURRA
Tibooburra
MILPARINKA
L. Altiboulka
142°30'
Scale: 15·78 Miles to 1 Inch.

FIG. 2

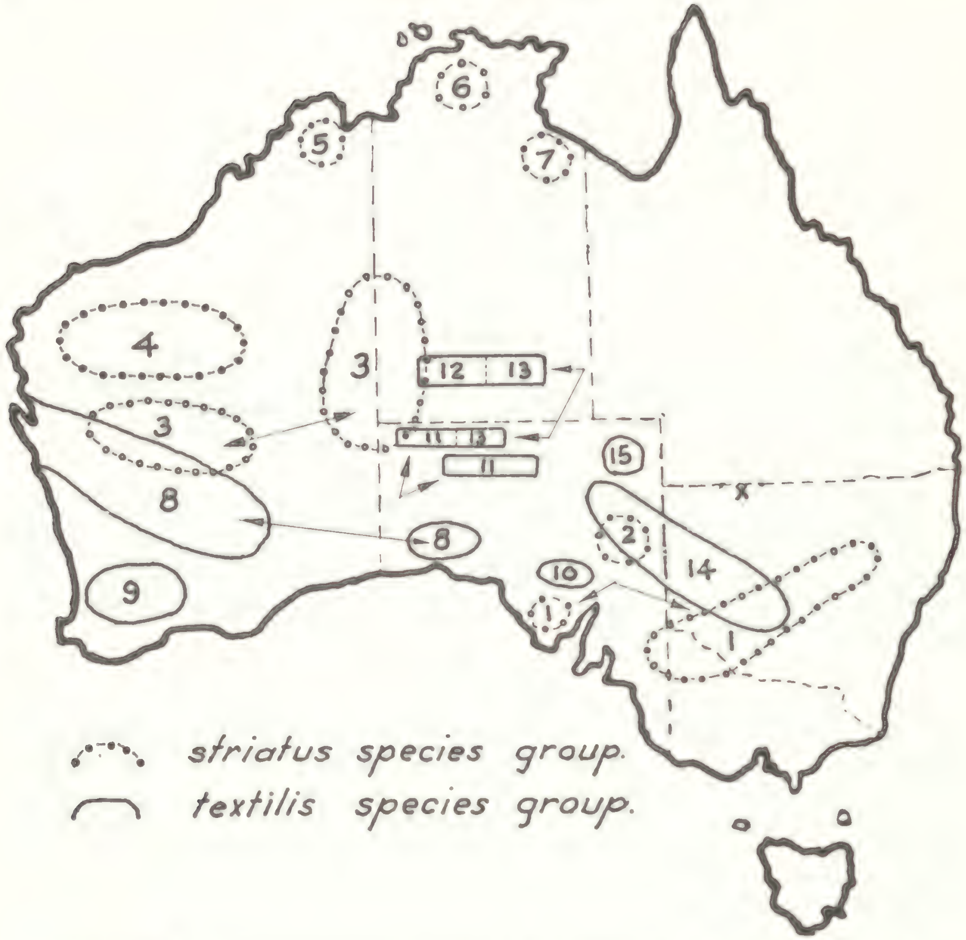

FIG. 1—Diagrammatic distribution of *striatus* and *textilis* species groups. 1, *A. striatus striatus*; 2, *A. s. merrotsyi*; 3, *A. s. oweni*; 4, *A. s. whitei*; 5, *A. housei*; 6, *A. woodwardi*; 7, *A. dorotheae*; 8, *A. textilis textilis*; 9, *A. t. macrourus*; 10, *A. t. myall*; 11, *A. t. everardi*; 12, *A. t. purnelli*; 13, *A. modestus modestus*; 14, *A. m. inexpectatus*; 15, *A. goyderi*; X, New species.

1. Holotype. Skin. Nat. Mus. Vic. B8911 ♂.
   Gonads enlarged, iris dark hazel, bill and palate black, legs and feet black.
2. Paratypes.
   (a) Skin. Nat. Mus. Vic. B8912 ♂.
   Gonads enlarged; soft parts as listed for holotype.
   (b) Skin. Nat. Mus. Vic. B8913 ♀.
   Gonads small; soft parts as listed for holotype.
   (c) Skin. Nat. Mus. Vic. B8914 ♂.
   Gonads enlarged; soft parts as listed for holotype.
   (d) Skeleton (almost complete). Nat. Mus. Vic. B8910. Sex?
   Bill black, legs and feet black.

Description

DORSAL: General colour gingery-brown (= Tawny Olive/Sayal Brown of Ridgway) suffused with grey and with white striations. Crown and forehead, narrowing to 'V' point at base of culmen, black with distinct white feather shafts giving the appearance of black striped with white; hind neck and mantle continuing these striations, the white shafts being narrowly edged with black and having gingery-rufous (= Sayal Brown of Ridgway) feather margins. Back and rump showing broad buff-white shafts, with the blackish shaft edgings more diffused; feather margins as on mantle but duller and with the dark grey of the feather bases emerging. Rump shafts much diffused. Tail shafts clear white, webs brownish-black fairly narrowly edged buff. Wing. Primary coverts blackish with cream-white shafts and narrow whitish feather margins. Secondary and lesser coverts, and scapulars, with broad buff shaft lines, blackish margins and pale buff edges. Primaries grey-brown with distinct cream-white shafts, narrow buff shaft margins, basal half of inner feather margins pale pinkish-buff (Ridgway) and basal portion of outer feather margin rufous (= Hazel of Ridgway). Secondaries darker and similarly but more distinctly marked and with more extensive buff inner margins.

LATERAL AND VENTRAL: Rictal bristles black, superciliary extending forward to nostril, white; lore and patch behind eye, black, creating a black line through the eye. Immediately below eye, white; auriculars white; chin and throat white; black feathering commencing in the malar region just anterior to auricular feathers and underlying them to provide a black margin posterior to auriculars, thence descending in a narrow band across lower throat sometimes meeting ventrally. Upper chest white. Mid-chest feathers white with dark grey bases and with longitudinal blackish stripes marginal to shaft, white edges and sometimes faint blackish tips, the marking being pronounced on sides of chest. Abdomen whitish, flanks pale buff. Under-tail coverts cream buff; ventral side of tail feathers similar to dorsal but duller and lighter. Wing, primaries and secondaries as for dorsal view but paler. Under wing coverts pale buff-white. Iris dark hazel, bill black, palate black, legs and feet black.

♀ Generally similar, probably a little smaller, and with chest markings less distinct.

DIAGNOSIS: Apart from the fact that it differs from all other *Amytornis* forms in its dorsal colouring, being more gingery-brown, the most striking diagnostic feature of the cabinet specimen is the black beard-like marking of the side-head and throat together with the general white colour of the under-parts. In the field however, as noted by one of the authors (N.J.F.) the head and throat markings are not distinctive and the most diagnostic feature of the species is its 'greyness' and upon this the common name, Grey Grass-Wren, is based.

MEASUREMENTS:

	Holotype ♂ B8911	Paratype ♂ B8912	Paratype ♂ B8914	Paratype ♀ B8913
	mm	mm	mm	mm
Length	183	185	196	178
Wing	58	58	59	57
Tail	109	111	118	103
Exposed Culmen	11	11	11·5	11
Tarsus (anterior)	22	22	24·5	23

Stomach contents from the specimens collected: mainly small seeds of several plant species, two small ants and remains of small Coleoptera. Several very small pebbles.

RANGE: Known to occur at Teurika and possibly occurring throughout the swamp-lands known as the Bulloorine, pronounced Bullareen, i.e. Caryapundy Swamp, Jerrira Swamp and Bulloo, pronounced Bulla, River Overflow, N.S.W.-Q'ld. (see Fig. 2).

HABITAT: Cane grass (*Eragrostis australasica*) clumps, and Lignum (*Muehlenbeckia cunninghamii*) thickets on the Bulloorine.

NEST SITE: See also Field Notes. Cane grass clumps and, less frequently, Lignum thickets.

NEST: See also Field Notes. The nest is bulky and very loosely constructed, varying in length overall from 8″ to 8½″ and in width from 4″ to 4½″. It is semi-domed with a large opening at the side. The size of the opening varies considerably, and is governed by the skill with which the individual building the nest constructs the hood. At times, the hood is so flimsy as to be almost non-existent, whilst other hoods appear to be almost detached from the main body of the nest itself. The majority of nests observed, however, have been well constructed, the entrance being 2″ wide by 1½″ in height. The interior of the nests are deep and cosy, 2″ wide by 3½″ in depth, lined with softer grass collected from the topmost portions of the cane grass, and a few small fibre-like rootlets. Parrot feathers and duck down are sparingly used, only two or three very small ones being found in any one nest.

Whether built in Lignum or in Cane Grass, the grass used to construct the outer walls of the nests observed was apparently from one species of *Panicum*. The colour of this grass noticeably, and, from the point of view of camouflage, effectively, showed marked variation.

In those built in Lignum and thereby exposed to sunlight, the grass, and therefore the nest, was from dark brown to black. But though exposed, the nest was extremely well camouflaged by matching its immediate environment. In those built in Cane Grass clumps the grass remained light brown but the nest was well-concealed by being placed in the centre of the Cane Grass clump.

EGGS: All sets collected were taken by N. J. Favaloro and William Adams, NW. of Teurika, N.S.W., July 7th, 1967, and are in the N. J. Favaloro Egg Collection. The eggs were fresh; four of them weighed 2·732 gr, 2·538 gr, 2·176 gr and 2·170 gr respectively. For oological notes on *Amytornis*, consult Campbell (1900), North (1901-1914, 1 : 248, 4 : 425), White (1914, 1924), and Whitlock (1924).

1. *First collected ('Type') set.* C/2. (a) Ground colour dull white without gloss and with a pale pink tinge evenly speckled all over with fine nutmeg brown markings, converging on the larger end to form a freckled brown cap. Measurements 19 mm × 14·7 mm (0·75 × 0·58 in.). (b) Ground colour lighter with a little gloss, sparingly marked with fine nutmeg brown markings, becoming more congested on the larger end to form a well defined zone, the markings within the zone being denser than those on the remaining portion of the egg. Measurements 19·5 mm × 14·7 mm (0·77 × 0·58 in.).

2. *Second set.* C/2. (a) Ground colour white unevenly but boldly speckled and blotched all over with heavy irregular nutmeg to reddish-brown markings. Measurements 18·2 mm × 15·5 mm (0·71 × 0·61 in.). (b) Ground colour dull white

with a slight gloss blotched with cinnamon brown somewhat lighter on the smaller end but concentrated on the larger end into broad dark brown cap of continuous colour with a few flecks of the ground colour emerging on the apex. Measurements 19·5 mm × 14·6 mm (0·77 × 0·57 in.).

3. *Third set.* C/2. (a) Colour very similar to specimen (a) of Set 1 being uniformly speckled all over but lacking the zoned effect on the large end, notwithstanding a slight concentration of markings in that region. Measurements 20 mm × 14·1 mm (0·79 × 0·55 in.). (b) Ground colour white with a pinkish tinge evenly blotched with cinnamon brown markings tending to form a small cap on the larger end. Measurements 17·9 mm × 14·6 mm (0·70 × 0·57 in.).

It will be noted that the clutch in each instance consists of two eggs only and that there is considerable variation in colour and pattern, not only beween eggs selected at random, but also between eggs of the one clutch. An evenly marked pair from a single nest would, on the limited information available at present, be regarded as unusual.

Also of interest is the range of variation in egg-size which, generally speaking, is smaller than that recorded for eggs of other species of *Amytornis*. The eggs are rounded-oval in shape, smooth, close grained and slightly glossy, especially where not heavily marked with blotches. A critical examination of clutches in the field and of the specimens collected has revealed an extraordinary variation from a dark and very heavily marked variety to lighter eggs delicately stippled with mauve undertones.

Even after making due allowance for changes in ground colour due to advanced stages of incubation, the eggs of *A. barbatus* are obviously more beautifully marked than those of *A. striatus*.

Ecology

(Based on field notes made by N. J. Favaloro, July 2nd-9th, 1967).

The source of the Bulloo River is near the northern extremity of the Grey Range in the far SW. of Queensland. The river flows in a general SW. direction along the entire length of the Range for approximately 375 miles to Bulloo Lake. In many places, the steep banks and the thick gum woodland remind one of the Darling River environs. The last fifty miles of the stream are still in their natural state. When Bulloo Lake overflows it spills out over an extensive area some 30 miles wide at its broadest point, and 70 miles in length. On very rare occasions, major flooding forces the water into Lake Altiboolka (known locally as Salsbury Lake) in New South Wales approx. 50 miles S. of the Queensland border.

The vast expanse of swamplands S. of the Bulloo Lake is known locally as the 'Bulloorine'. It is shown on the accompanying map as Caryapundy Swamp, Jerrira Swamp and the Bulloo River Overflow. The whole area is traversed by a series of broad and narrow channels, many deep enough to sustain permanent water holes, others so shallow that they dry out quickly after the flood waters recede. Some sections of the Bulloorine are so overgrown with giant Lignum bushes that it is impossible to drive a car between them, but on the more open flood plains, Cane Grass (*Eragrostis australasica*) and small Lignum *Meuhlenbeckia cunninghamii* make travelling possible and more pleasant.

Apart from the major and minor flooding of the Bulloo River from time to time, Lake Woodburn and Caryapundy Swamp receive a plentiful supply of fresh water from local rains in normal seasons. The result is that the Bulloorine is a rich

isolated habitat surrounded by arid stony country where desert conditions predominate. It was on a remote section of the flood plains where *Acacia* sp. dotted the landscape and the Cane Grass and Lignum grew in association with a herb/shrub flora of Nightshade (*Solanum lacunarium*), Bluebush (*Chenopodium auricomum*) and Mitchell Grass that the Grey Grass Wren was discovered.

Favaloro's first encounter with *Amytornis* in the vicinity of the Bulloo was accidental. When returning from a short visit to the Onobootra Water Hole on the 24th September, 1942 in company with Mr A. Storer, an *Amytornis* was flushed from a dense clump of Lignum. Only a dorsal view was obtained and he noted that it was much lighter in colour than *A. striatus* with which he had had considerable experience. Some years later, he discussed this sight record with Dr A. Keast who subsequently referred to it (Keast 1958) under the heading of '*A. modestus*'.

The opportunity of returning to the locality did not come again until July, 1967, when in company with Mr William Adams, Favaloro made an attempt to visit the area known as 'the island' bounded on the east by the Caryapundy Swamp, on the west by the Jerrira Swamp and on the south by the Bulloo River Overflow. However the Bulloo was in flood and local rains had aggravated the position, thus making it impossible to cross the western channels by car. As Mr Adams had a thorough knowledge of the intricate and complex system of sandridges and channels to the SW. of the Lake, it was possible to reach similar habitats within a 25 mile radius of the Teurika homestead.

About 9.30 on the morning of 7th July, 1967 Favaloro and Adams were examining an isolated section of Cane Grass in which clumps of Lignum were growing, when Favaloro saw five greyish birds about the size of House Sparrows (*Passer domesticus*) perched on the topmost canes of the Lignum. No difficulty was experienced in approaching close enough to identify the birds as being members of the genus *Amytornis*, and even without the aid of binoculars, it was apparent that the colour and the pattern of the birds' markings were distinctive and different from any other known species of this genus.

After being observed for some time, the birds descended into the interior of the Lignum bush where they kept up a prolonged twittering, the notes being soft double syllabled and high pitched. The birds were difficult to flush, but when this was done, they flew rapidly with their tails trailing horizontally in a manner resembling members of the *Malurus* group. Although observed on many occasions running and bouncing along in typical *Amytornis* fashion, they more frequently flew from bush to bush and from one Cane Grass tussock to another. The bird's preference for flight has probably been developed as the result of the habitat in which it lives.

In the habitat of *A. striatus*, Porcupine Grass clumps grow so closely together that it is both safe and easy for this species to pass quickly on the ground from one tussock to another. The Grey Grass Wren, on the other hand, has by comparison considerable distances to travel between patches of vegetation for food and shelter. When flushed, individuals of this species fly quickly from cover to cover at a height of approximately one foot from the ground, but when making a voluntary journey they usually launch themselves into the air from a vantage point at a height of two or three feet, and fly swiftly in a direct line to the base of their objective where they quickly take refuge in the undergrowth or seek the protection of the Cane Grass.

Although the breeding season was at its height, there was no indication of any nuptial song similar to that of the Striated Grass-Wren. Whenever the Grey Grass Wrens were located, their double notes could be heard as they twittered and called to each other from the interior of the dense Lignum thickets. Here again, the

contrast between the two species is noteworthy. Noise or movement not only causes *A. striatus* to take cover but also results in the bird remaining quiet and out of sight for a long period. On one occasion early in the morning while two birds were observed sunning themselves on top of a Lignum bush, they were joined by a third. All three were calling intermittently as the latest arrival approached and eventually took up a position close to the bird near the end of the branch. After a short interval, but without further ceremony or display, mating took place. The female remained to preen herself as the male returned to the centre of the Lignum. An extensive and methodical search was then made for the nest. The first one discovered contained two eggs slightly incubated. It was found in Lignum at a height of 18 in. from the ground in an exposed position, and was not hidden or protected in any way. Three other nests found in Lignum were all in similar situations, varying from 12 in. to 2 ft 6 in. from ground level, and built on the N. or NE. side of the clump. With one exception, all were facing towards the outside of the bush. The exception was a small poorly constructed nest with its entrance facing the centre of the Lignum. The acute angle of its hood so concealed the entrance that it would have been difficult to see in any event. This nest contained two very heavily incubated eggs.

The most favoured nesting sites were in the Cane Grass tussocks, but the majority of these nests were either old or just being built. Some were as easy to find as others were difficult. Debris left behind in the Cane Grass by the rise and fall of flood waters made the task harder and every clump had to be carefully examined. Three nests found in Cane Grass had been built on the remnants of previous nests. It was noted too that those built in Cane Grass tussocks were invariably upright, whereas nests built in Lignum tended to deviate from the perpendicular, and were more flimsy in structure, particularly the hood which was so frail that it was impossible to remove the nests or move the Lignum itself without causing considerable damage. Nests with flimsy hoods and enlarged openings lost the half-domed appearance characteristic of the more typical examples.

Conclusion

The fact that an *Amytornis* so different from every other known form of the genus should remain undiscovered for so long raises two important questions. Firstly, what is the extent of its distribution generally, and secondly, what is the numerical strength of the new species?

The present observations revealed four colonies scattered over a distance of 25 miles from Teurika to a point approximately five miles over the Queensland border. The number of individual birds seen totalled 45, giving an average of five or six pairs per colony in each instance.

The plumage of juveniles has still to be recorded and there is not sufficient information available to establish with certainty whether the small differences between the male and female as described in this paper are constant. It is indeed possible that there are no substantial plumage differences between adult males and females. The extent of the breeding season also calls for investigation. The question arises as to whether this is influenced by seasonal conditions associated with the arid nature of the country on the one hand, or by the more regular flow of water from the Bulloo River on the other. If by the former, then the breeding season would be irregular as it is with most of the resident inhabitants of and migrants to the adjacent stony rises and plains, but if by the latter, then the Grey Grass-Wren

may be expected to nest more regularly during the months of July, August and perhaps September each year, except during periods of extreme drought.

TAXONOMIC RELATIONSHIP: Morphologically *Amytornis barbatus* clearly belongs to the *striatus* group on the basis of its bold and complicated plumage pattern. One might therefore expect it to possess a song approaching or surpassing that of *A. striatus*. No such song however has yet been recorded. Its bill, reflecting its chiefly seed-eating habit (see stomach contents), is more robust than that of *striatus*. In these features therefore it is more akin to the *textilis* group. But to go beyond this comment on present information would be no more than speculation.

Acknowledgements

Grateful acknowledgement is made to Mr Noel Connard for preparation of the maps and to Mr R. T. M. Pescott, Director, Royal Botanic Gardens and National Herbarium for identification of plant species.

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Explanation of Plates

PLATE 1

Approximately $\frac{2}{3}$ natural size

Fig. 1-3—*Amytornis*. Ventral view: (1) *A. barbatus* (holotype); (2) *A. t. purnelli*; (3) *A. s. striatus*.

PLATE 2

Approximately $\frac{2}{3}$ natural size

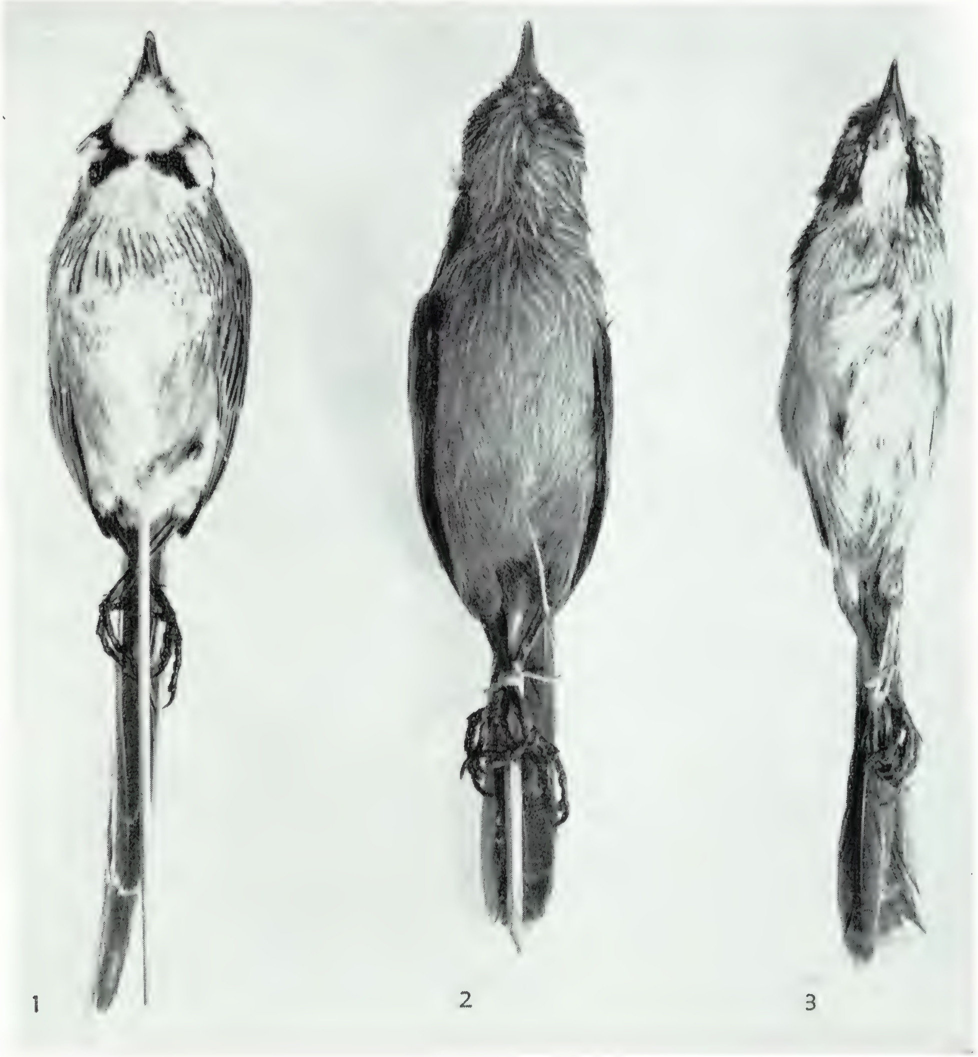
Fig. 1-6—*Amytornis*. Lateral view: (1) *A. barbatus* (holotype); (2) *A. t. purnelli*; (3) *A. s. striatus*. Dorsal view: (4) *A. barbatus* (holotype); (5) *A. t. purnelli*; (6) *A. s. striatus*.

PLATE 3

Nest of *A. barbatus* (with cotton-wool inserted) in Cane Grass clump. Inset shows entire clump, approximately four feet high, the arrow indicating position of nest.

PLATE 4

Fig. 1-4—Habitat: (1) General view; (2) Cane Grass clump containing a nest; (3) Lignum containing a nest; (4) Nest in Lignum disclosed.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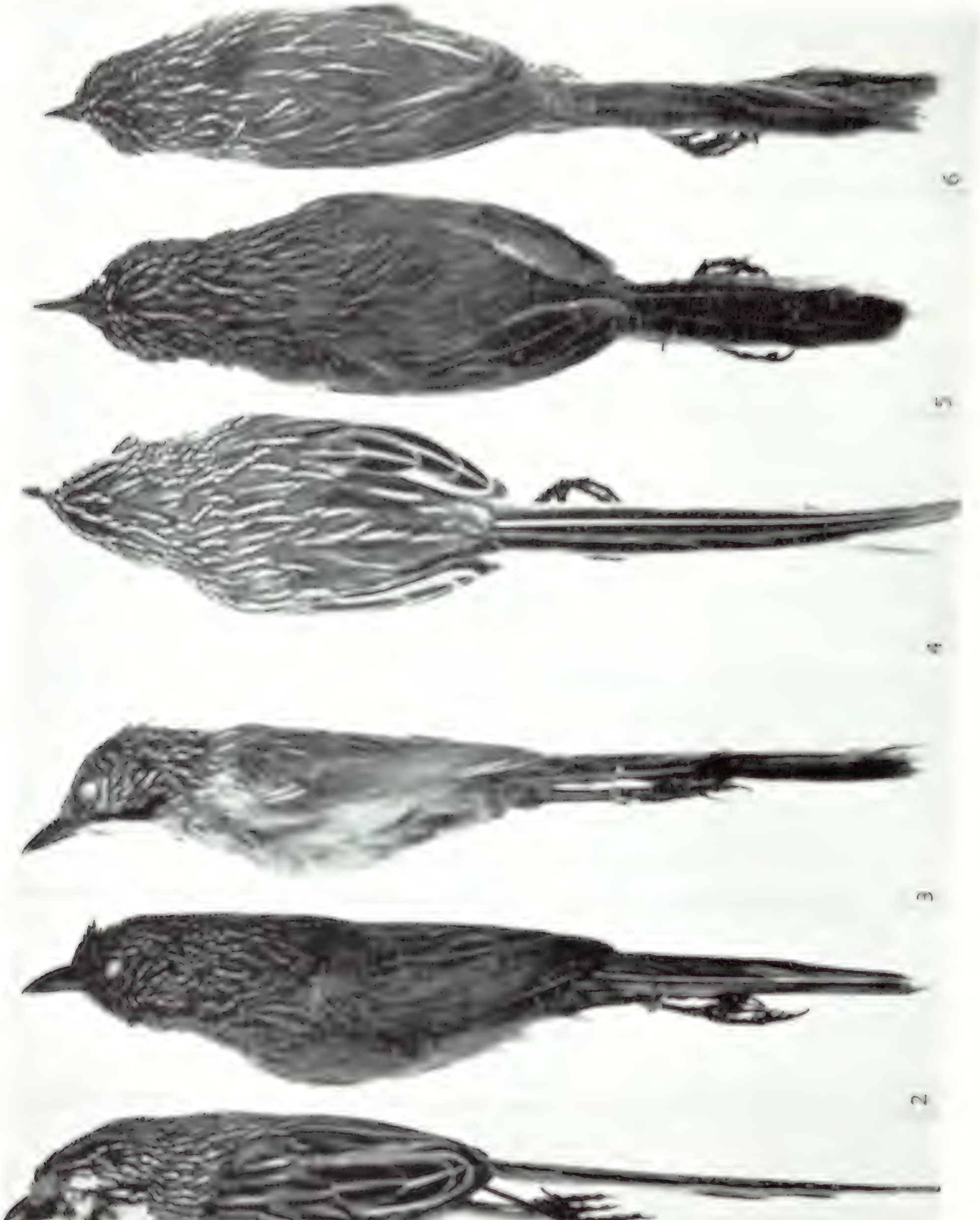
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THE AUSTRALIAN WEEVIL GENUS *NYELLA*[1]

(Coleoptera: Curculionidae: Baridinae)

By Elwood C. Zimmerman

Bishop Museum, Honolulu, Hawaii

Since Charles Oke described *Nyella* in 1931, it has remained an enigma. Oke placed it originally under the heading 'Incertae Sedis', and said that 'The position of this genus is doubtful, but the table of Le Conte and Horn, in the Classification of the Coleoptera of North America, indicates a grouping with the Trypetini'. In 1934, Oke reported upon a more detailed examination of the weevil, and he then transferred it to the Cryptorhynchinae. *Nyella* is listed in the Trypetini of the Cossoninae in *Coleopterorum Catalogus*, pars 149: 108, 1936. *Nyella* does not belong to the Trypetini or to the Cryptorhynchinae. Oke either misinterpreted the characters of *Nyella* or he misread the Le Conte and Horn key, because in that key one is led straight to the Baridinae where *Nyella* belongs. It is unfortunate that Oke did not submit a specimen to a specialist on the Curculionidae who could have assisted him in assigning the weevil to its correct subfamily. I have been interested in ascertaining the taxonomic position of *Nyella* for a long time, because I have been working on the genera of the Indo-Pacific Baridinae. I had tentatively concluded from a study of Oke's illustrations that *Nyella* belongs to the Baridinae, but I was unable to confirm that opinion until I was able to study a specimen. Oke's description is inadequate and it is in part erroneous.

It was thought that only a type pair of the weevil, mounted on a single card, was in the National Museum of Victoria at Melbourne and not available for loan. Recently, however, Mr A. Neboiss, Curator of Insects of that institution, searched through Oke's collection and found the unlabelled, partly dismembered third specimen that Oke mentioned in his 1934 report, and the specimen has been loaned to me for study. I am now able to present the results of my examination as follows:

Subfamily Baridinae

Genus **Nyella** Oke

Nyella Oke, *Proc. Roy. Soc. Victoria* 43: 200, fig. 6g, h, i, 1931. Same journal 46: 262, 1934, expanded description.

Nyella bears some resemblance to such genera of squamose Baridinae as *Lophobaris* Marshall. It may be characterized as follows (from the single damaged male I have seen):

Body and legs densely squamose. *Head* and rostrum with dorsal contour slightly discontinuous (but appearing more abruptly discontinuous on type because of erect squamae on base of rostrum and interocular area and prostrate squamae on head); ventral margins of eyes extending a little ventrad of ventral origin of rostrum. *Rostrum* (described from a male) comparatively stout, gently arcuate, its length (measured along the ventral chord from apex of mandibles to base) less than

[1] This is number 17 of a series of publications resulting from studies made possible by National Science Foundation Grant G-18933.

1

2

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three-fourths as long as pronotum; basal interocular distance, as seen in direct frontal view, much greater than breadth of an eye; broader distad of antennal insertions; mandibles strongly bidentate and normally decussate; scrobes with their apices visible in dorsal view, thence passing from dorsal view caudad beneath sides of rostrum, the caudal ends of their dorsal margins directed to about the ventral one-third of the eyes and their apices widely separated on underside of rostrum. *Antennae* (in male) inserted very near middle of rostrum (as measured along ventral margin); scape subequal in length to the seven funicular segments combined, its apex reaching base of rostrum and almost touching eye; funicle with first segment (measured along its greatest length) as long as segments two, three and four combined; club ovoid, about as long as funicular segments three to seven combined, its first segment moderately setose. *Prothorax* with feeble postocular lobes; pronotum strongly transverse (about 4·0 : 6·5 on type-species), broadest at base, basal margin strongly sinuous. *Scutellum* unusual, small, deeply immersed and mostly hidden. *Elytra* broad, broadest near posterior parts of the prominent humeri; basal margin strongly sinuous and with the scutellar emargination deep; striae one, seven and eight not reaching base, stria 10 distinct above most of metepisternum and caudad but not above ventrites one and two. *Legs* with trochanters lacking, long, slender, differentiated sensory setae; femora moderate, the posterior pair not reaching elytral apex, denticulate beneath at about middle and moderately impressed from the largest tooth to apex for reception of basal parts of tibiae; tibial uncus well developed, mucro small (metatibiae wanting from specimen studied); tarsi with segment one (excluding basal bulbose part) subtriangular, longer than two which is transverse, segment three much broader than two and deeply bilobed, the claw segment extending beyond apex of two and its claws strong and moderately divergent. *Prosternum* with anterior margin deeply emarginate; subapical constriction strongly marked; broadly, shallowly, medially canaliculate with vestiges of side walls to the canal cephalad of coxae; area cephalad of coxae shorter than length of a coxa and about twice as long as area caudad of coxa; procoxal separation subequal to transverse diameter of a procoxa; the poststernellum widens strongly to behind procoxae and there it has raised lateral margins and is about twice as broad as the narrowest intercoxal distance (but it does not extend caudad of prothoracic margin), it abuts the intercoxal process of metasternum and its longitudinal contour is discontinuous with that of metasternum. *Mesosternum* normally concealed from view excepting a small tubercle-like lobe of the mesosternellum at each side of the anterior margin of metasternum adjacent to mesocoxae; mesosternellum completely vertical and the suture between it and metasternum normally entirely concealed, except at lateral lobes, except when prothorax is disengaged, and then the suture can be distinguished on the vertical wall combining the mesosternellum and anterior margin of the metasternum; mesocoxae widely separated, distance between them about twice the breadth of a coxa and twice as widely separated as procoxae; mesopleura broad, suture between them vestigial. *Metasternum* transverse, median length subequal to that of ventrite one; cephalic margin straight; metacoxal separation subequal to length of mesocoxa; metepisternum broad. *Abdomen* broad; intercoxal process of ventrite one gently arcuate; suture between ventrites one and two obsolete in middle; ventrite one a little longer than ventrites two and three combined along median line; ventrite two longer than three plus four which combined are somewhat longer than five (the male has a distinct median process on caudal margin of five); pygidium concealed

from view from directly above but its apical part vertical, strongly transverse and distinctly exposed to view from behind or below.

TYPE SPECIES: *Nyella tuberculata* Oke, by monotypy and original designation (Pl. 5 and Fig. 1-4).

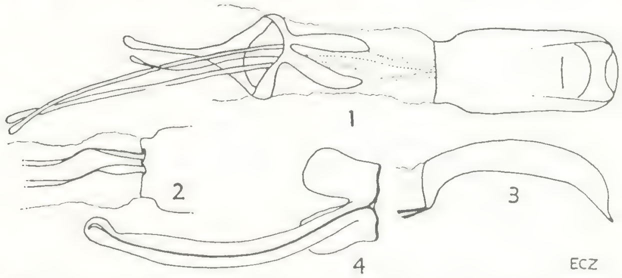


FIG. 1-4—Details of a male *Nyella tuberculata* Oke: 1, dorsal view of aedeagus and associated structures; 2, ventral view of base of aedeagus to show attachment of apodemes; 3, lateral view of aedeagus; 4, ninth sternite ('urosternite', 'spiculum gastrale'). All drawings to the same scale.

Our ignorance of the Australian and Indo-Pacific Baridinae is so great that it is of little use to attempt to discuss at this time the relationships and place of *Nyella* in the Australian fauna. It is probable that several hundred Australian Baridinae exist, but evidently less than 75 species have been described in about 10 genera. More than one-half of the described Australian Baridinae have been placed in '*Baris*' where perhaps few of them belong. Most of the species were described by Lea, and the entire Australian barid fauna is in great need of revision.

Nyella tuberculata is an unusual barid, and one might not recognize it as a barid at first sight in dorsal view. The densely squamose, fasciculate dorsum and its broad form recall some of the species of *Oroclesis* in the Cryptorhynchinae or perhaps some Erirhininae such as *Storeus*. The nature of the scutellum and mesosternum are noteworthy features. Oke described the dorsum as tuberculate, but it is really fasciculate with low swellings beneath the large fascicles on elytral intervals three, five and seven. The fascicles contain elongate, erect yellow and black squamae, and not only black squamae as originally described. The crown of the head is densely clothed with prostrate, ovate, stramineus squamae that are more elongate distad, and the interocular area and base of the rostrum have erect, elongate-ovate squamae. The rostrum otherwise is without squamae. The dorsum of the rostrum in the male behind the antennae is comparatively coarsely punctate with the punctures tending to be longitudinally subconfluent, but there are no carinae. The pronotum is strongly transverse with the breadth: length proportion as 65 : 40; most of the elongate-ovate squamae are prostrate and stramineus to golden yellow, laterad they are more imbricated, and there is a large, conspicuous, submedian fascicle of erect squamae, a suberect cluster of squamae on either side of the apex and another near the middle of each side margin of the pronotum. The placement of most of the fascicles on elytral intervals three, five and seven can be seen on the photographs, but there is a small cluster of erect squamae basad of the large fascicle on each third interval that is largely obscured in the photographs. The elytral intervals have the derm coarsely reticulate, do not bear setae, and, excepting for the erect squamae in the clusters and fascicles, most of the squamae are elongate-ovate, imbricated so as to conceal most of the derm and stramineus to golden yellow. The strial punctures are small, and each bears a narrow, prostrate, sub-

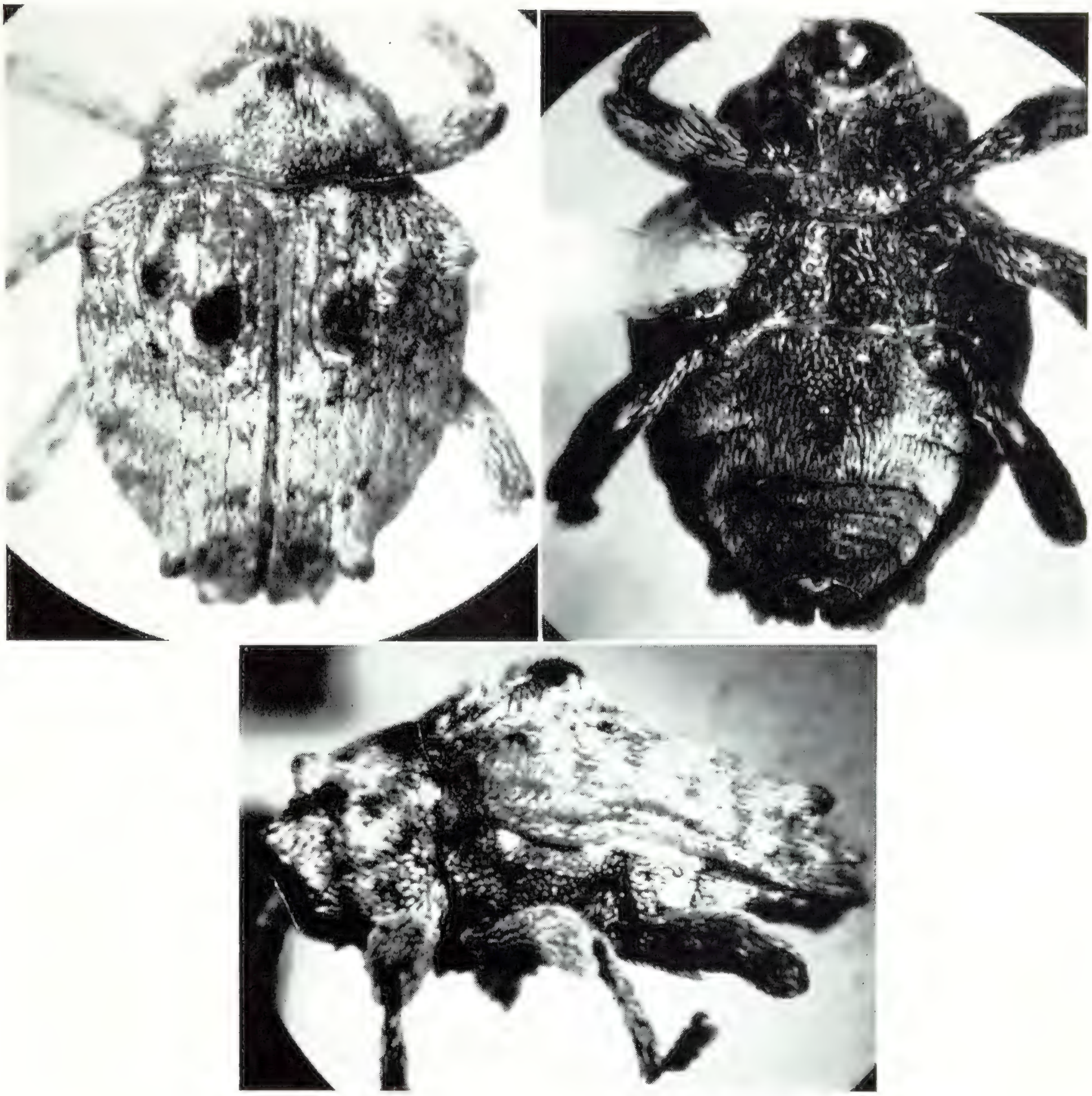
squamiform seta. The ventral surfaces are mostly less densely squamose than the dorsum, but the squamae are dense at the sides of the first four abdominal segments. The median and submedian areas have more setiform vestiture. In the original description the profemora are described as 'distinctly emarginate below'. This is erroneous, and the projection of the ventral denticles evidently was misinterpreted as an emargination. The single male I have examined measures 3·5 mm in length, excluding the head, and it is 2·4 mm in breadth across the elytral humeri.

The type locality is Mitchell Gorge, Victoria, and the host plant is *Rapanea variablis* (mutton-wood).

Explanation of Plate

PLATE 5

Dorsal, ventral and lateral views of a male *Nyella tuberculata* Oke, head removed (Photographs by David Kissinger).



3

NEW PLATYPODID FROM AUSTRALIA

Contribution 148 to the morphology and taxonomy of the Scolytoidea

By KARL E. SCHEDL
Lienz, Tyrol, Austria

Mr A. N. Burns, when Curator of Insects at the National Museum of Victoria, sent to me three specimens of a new Platypodid from New South Wales. Three further specimens from Victoria were supplied later. The species is rather difficult to place in one of the known groups or within the genus *Platypus* Herbst but will, most probably, represent the type of a new division. This question will be dealt with elsewhere.

Platypus incompertus n.sp.

(Pl. 6)

All specimens most probably are males. Reddish brown, 6·5 mm long, 1·5 mm wide.

Front flat, with a shallow depression in the upper half, very densely covered with coarse punctures, the narrow interspaces minutely punctulate, pubescence sparse, almost absent in the anterior half, rather long towards the vertex.

Pronotum longer than wide (ratio 1·23 : 1 or 12·5 : 10·2 lines on my micrometer) covered with shallow punctures of varying size and density, surface of interspaces with silky shine, minutely punctulate; the median sulcus very long, extending a little beyond the centre, in the median third of the pronotum surrounded by an elongate heart-shaped patch of fine, very densely placed and uniform sized punctures, pubescence sparse but rather long; femoral emarginations long and moderately deep.

Elytra slightly wider (1·11 : 1 or 11·3 : 10·2 on micrometer) and 2·4 times longer than pronotum, the sides subparallel on the basal three fifths, thence slightly and obliquely narrowed, the apex transverse up to the fifth interstice, declivity commencing at the posterior quarter, obliquely convex; disc striate-punctate, the striae rather narrow and well defined, the strial punctures small and densely placed; the interstices flat, moderately wide, minutely punctulate, with silky shine and a row of additional small and sparsely placed punctures along the middle; the base of the third interstice slightly widened, somewhat elevated and transversely rugose; declivity with the striae distinctly more impressed, the interstices more convex, each of them with a rather regular row of densely placed pointed tubercles, those of the first interstices distinctly smaller than the following ones, a set of similar but larger serrations along the lateral margins up to the postero-lateral angles, the posterior quarter of the declivity somewhat flattened, and steeper, the tubercles of the interstices noticeably reduced.

TYPE MATERIAL: Holotype ♂ in the National Museum of Victoria (T 134) Eden, N.S.W. 23 Oct. 1953. L. H. Bryant ex *Eucalyptus siberiana* Ireland Timms Ltd.

Five paratypes ♂ ♂: 1 paratype Eden, N.S.W. (data as for holotype) K. E. Schedl Collection; 2 paratypes Woodhouse Creek, North of Omeo, Vict. Nov. 1964

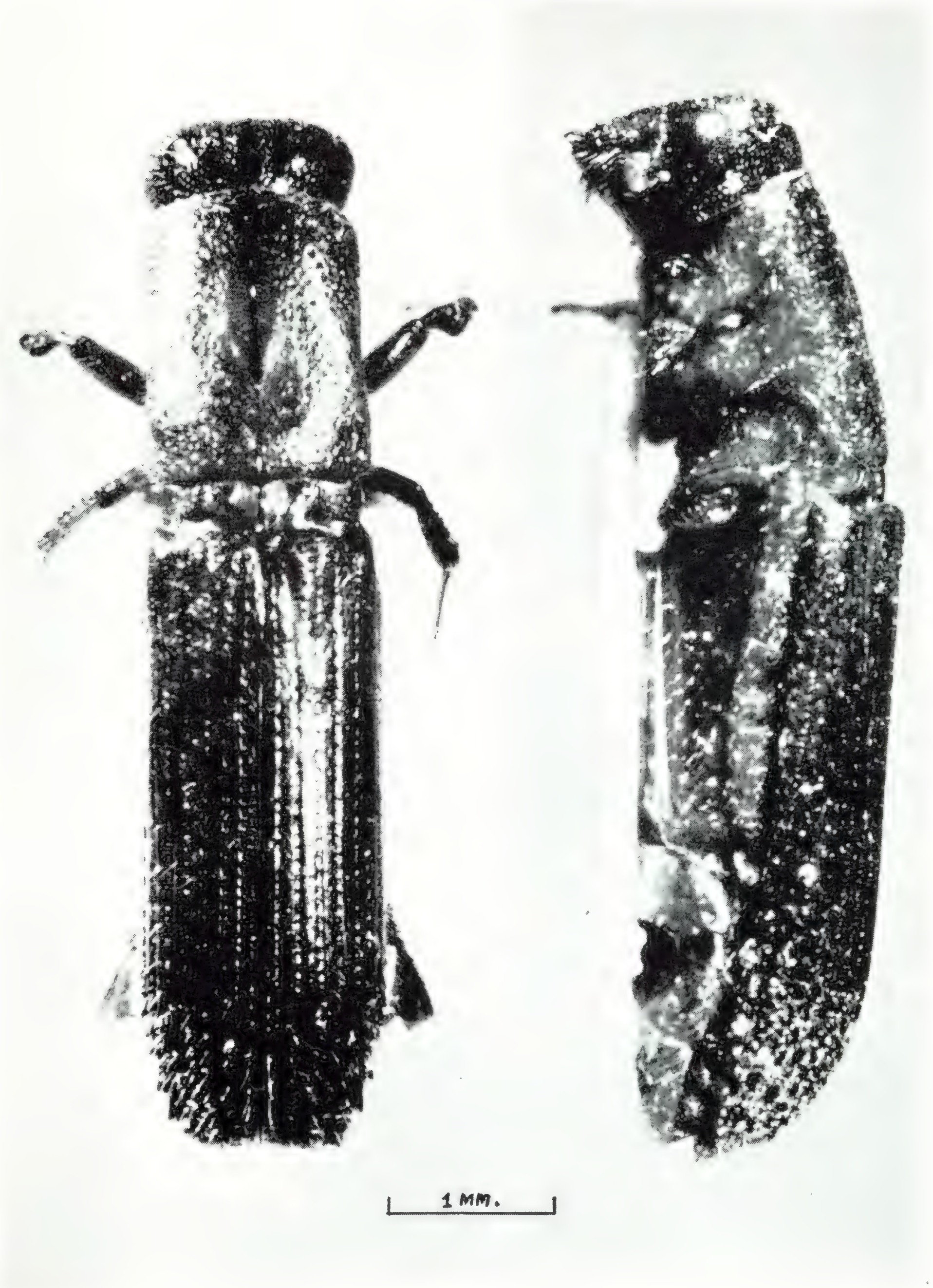
ex *Eucalyptus delegatensis* in Nat. Mus. Vict. Collection (T 3731; T 3732); 2 paratypes nr. Omeo, Vict, Nov. 1965. One in K. E. Schedl and one in Nat. Mus. Vict. Collections (T 3733).

DISTRIBUTION: SE. New South Wales and Eastern Victoria.

Explanation of Plate

PLATE 6

Platypus incompertus n.sp., holotype male. Left: dorsal view. Right: lateral view.


1 MM.

4

LARVA AND PUPA OF *CUPES VARIANS* Lea,

and some observations on its biology (Coleoptera; Cupedidae)

By Arturs Neboiss
Curator of Insects

Ever since the European house borer, *Hylotrupes bajulus* L., was discovered in pre-cut houses imported into Australia between 1948 and about 1952, the Victorian Government has co-operated with the Commonwealth Quarantine authorities in an active campaign to discover and eradicate this pest. In the course of surveys made to detect *Hylotrupes* in imported houses, some damage caused by other insects was discovered and, where necessary, appropriate treatment recommended and applied.

Amongst the more interesting insects discovered in these surveys was *Cupes varians* Lea. The insect was discovered in partially decayed spruce (*Picea abies*) used as a plinth to a weatherboard house at Puckapunyal, near Seymour in Central Victoria. The damaged timber was submitted to the Division of Forest Products, CSIRO, in the mistaken belief that the damage might be due to *Hylotrupes*. Officers of the Division recognized that this was not so, and referred the damaged timber, and the insects to the author for examination.

Detailed study of the infested wood showed that the insect damage was confined to those portions of the board which had rotted through ground contact, indicating that the insect requires decayed wood and, probably, a relatively high moisture content in the wood it attacks. The larval galleries were typical of those of the 'longicorn' group of wood borers, in that they were oval in cross-section and followed along the grain of the wood, usually avoiding the harder autumn wood. The galleries were tightly packed with abundant frass in which distinct pellets were occasionally visible.

In addition to larval galleries, the attacked wood contained three or four pupal chambers, (Pl. 7, fig. 1), which are enlarged sections of the larval galleries, but isolated from them by a plug of tightly packed frass. These chambers were of a flattened, elongate oval shape, measuring about 4 mm by 7 mm wide with an average length of about 22 mm.

The damaged wood yielded two full-grown larvae, two pupae and one adult, freshly emerged from its pupal case (Pl. 7, fig. 2).

Description: Mature larva—length 20·5 mm; width (thoracic segments) 2·8 mm; form elongate, somewhat cylindrical with distinct lateral ridge; sixth, seventh and eighth abdominal segments shorter and slightly wider than the preceding ones; the entire body covered with fine, sparse pubescence.

Head wider than long, rounded laterally, median suture distinct. Most of the mouth parts ferruginous, distinctly darker than frons and epicranium; distal half of the clypeus as well as the four segmented antennae pale yellowish. Labrum 3·5-4 times wider than long, densely covered with fine short pubescence; anterior margin concave. Mandibles with cutting edge forming three distinct teeth, the lower one recessed; molar structure slightly narrower than the mandible itself (Fig. 8).

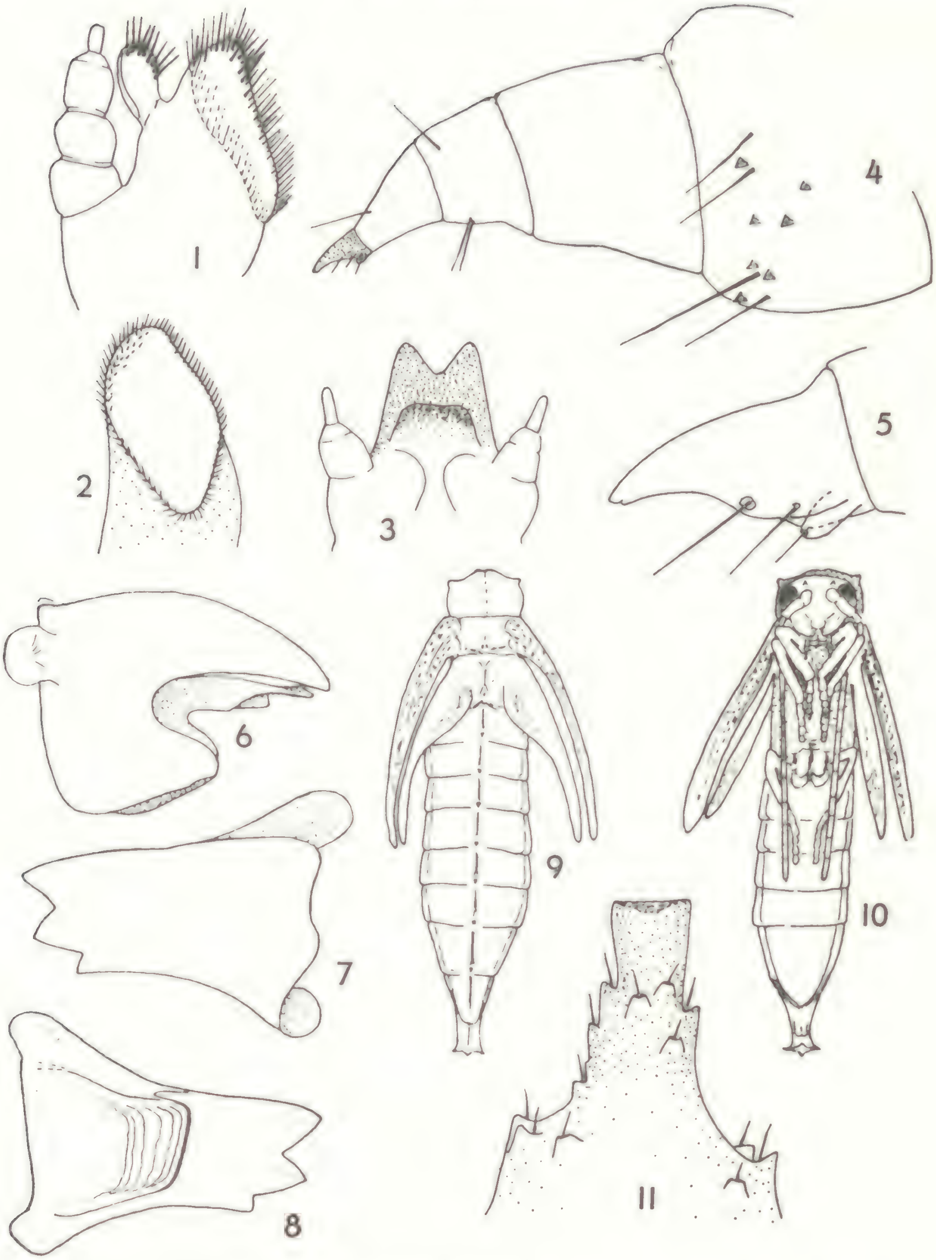


FIG. 1-11— 1, maxilla; 2, lacinia—inner surface; 3, labium; 4, front leg; 5, claw; 6, mandible—ventral view; 7, mandible—outer surface; 8, mandible—inner surface; 9, pupa—dorsal view; 10, pupa—ventral view; 11, larva—apex of the 9th abdominal segment.

Maxilla rather short and broad; lacinia and galea separate and of the same length as the maxillary palp. Lacinia covered with short, strong bristles along the inner margin and forms a complete elongate ring; galea with similar type bristles located at distal end. Maxillary palpi four segmented. Labium strongly chitinized with deep V-shaped incision at distal end (Fig. 3); mentum and ligula fused; labial palpi two segmented.

Thoracic segments similar in size, legs short, claws fused (Fig. 4 and 5). Ventral surface of the first thoracic segment with chitinous spiny plate between the legs. A few short, stout chitinous spines on the inner surface on all coxae; femurs, tibiae and tarsi with a few fine, long hairs.

The first three abdominal segments approximately as long as wide; fourth and fifth slightly longer than wide; sixth to eighth distinctly shorter than wide; ninth, conical, terminates with strongly chitinized short cylindrical projection which has a concave depression at the distal end and a number of irregular chitinous spines at its base (Fig. 11).

Pupa (Fig. 9 and 10) length 13-13·5 mm width; (widest abdominal segment) 3-4 mm. On pupation the larval skin splits dorsally and is pushed posteriorly where it stays with the pupa.

Head bent down under the thorax, and could not be seen from above. Eyes prominent, dark; antennae outwards and towards the ventral side of the thorax where they are placed longitudinally and parallel to the tarsal segments of the legs and reach third or fourth abdominal segment, about as far as the third pair of legs. Elytra and wings extending as far as fourth abdominal segment; sculpturing of the elytral pattern visible. Pronotum with prominent anterior angles, median line slightly depressed. Meso- and metathorax with elevated tubercles at the centre of the posterior margin. Abdominal tergites with a distinct median keel, which is more pronounced apically; occasionally on each segment near the highest point at the posterior margin there is a short chitinous spine.

LOCALITY: Seymour (Puckapunyal Army Camp), Victoria, 15 Oct. 1963. (House erected 1951). Specimens in the National Museum of Victoria collection.

A pupa of another species—*Cupes eumana* Neboiss was found by K. M. Moore at Lisarow, N.S.W. on 25th September, 1956, and the adult emerged 30th September, 1956. Pupa has been taken from 'rotted scrubwood' but no further biological data of this specimen are available.

Acknowledgements

The author is grateful to Mr J. Beesley and Mr D. Howick of CSIRO Division of Forest Products for their valuable assistance and criticism.

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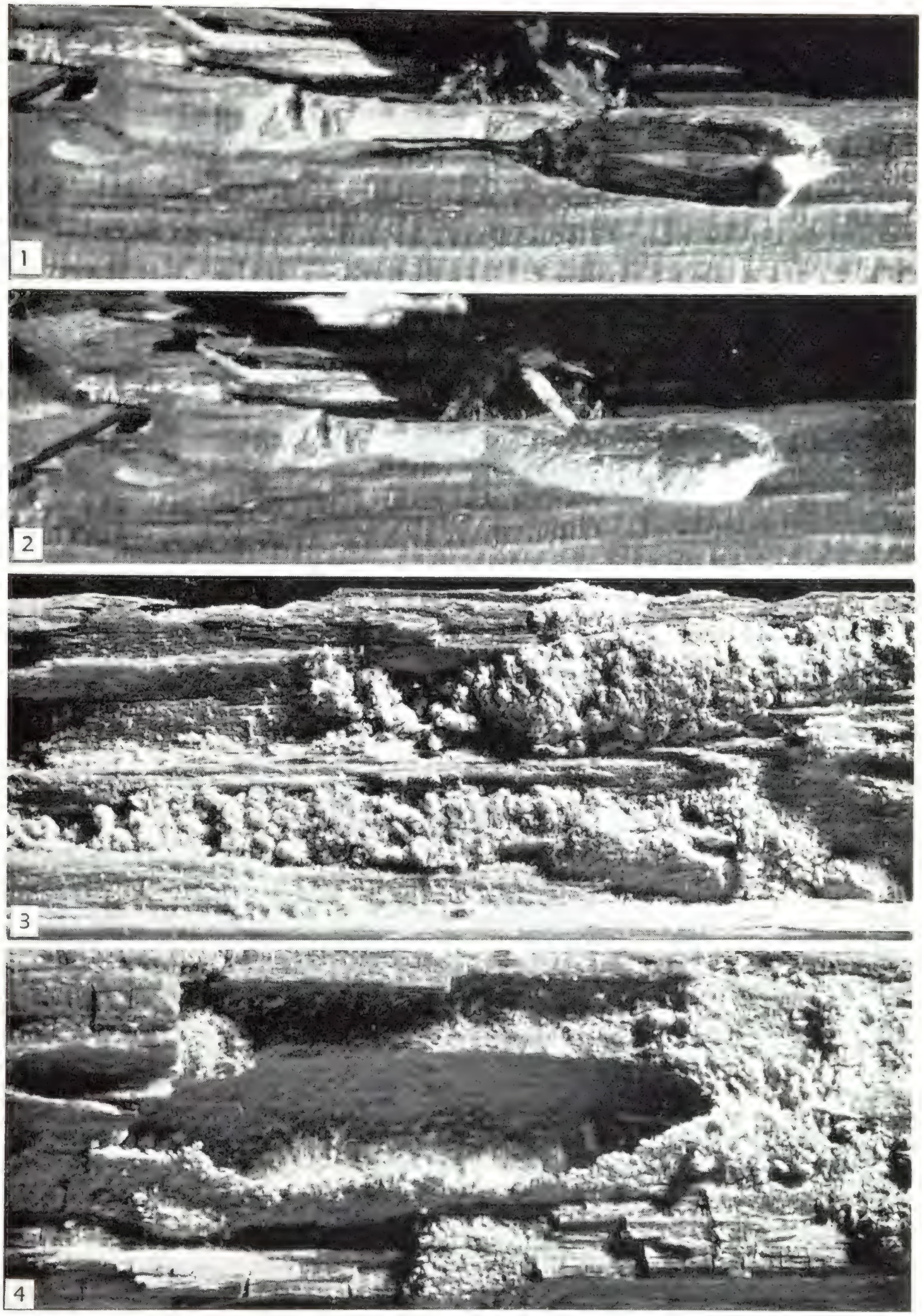
Explanation of Plate

PLATE 7

Fig. 1—Newly hatched adult in pupal chamber.
Fig. 2—Pupal chamber with specimen removed.
Fig. 3—Larval galleries showing tightly packed frass and pellets.
Fig. 4—Pupal chamber.



5

THE TYPE OF *OMMA MASTERSI* Macleay
(Coleoptera; Cupedidae)

By Arturs Neboiss
Curator of Insects

In a previous paper (Neboiss 1960) it was noted that the type specimen of *Omma mastersi* Macleay could not be found in the collection of the Australian Museum, Sydney, and that the type label had been wrongly placed on a much larger specimen of the Cupedidae, *Omma stanleyi* Newman. Since publication of the above mentioned paper, it has come to the author's notice that the type specimen of *Omma mastersi* had been illegally removed from the Australian Museum's collection and, after some years, had been returned to its rightful owner. The author has examined this specimen and found that it fully agrees with the original description published by Macleay. In the author's opinion, this specimen is the type specimen of *Omma mastersi* Macleay.

References

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6

AUSTRALITES FROM PRINCETOWN, VICTORIA

By GEORGE BAKER

Abstract

Seven australites recently discovered along a new road N. of Princetown township on the S. coast of Western Victoria serve to extend the area of distribution of tektites in the Moonlight Head-Port Campbell-Peterborough concentration centres of the Australian strewnfield.

The state of preservation of the specimens is such that they still reveal some of the features arising from the effects of the secondary process of aerodynamic heating and ablation generated during hypersonic transit through the earth's atmosphere. Tertiary processes such as natural solution etching in soils and terrestrial exfoliation that have occurred during the few thousand years the specimens have lain on the earth's surface have somewhat modified the original primary (extraterrestrial) and the secondary (aerodynamic) surfaces.

Introduction

Seven australites from a new branch road six miles N. of Princetown (Fig. 1) on the S. coast of Western Victoria were collected by Mr Eric Franks of Coburg Victoria, in January 1965. They reveal a state of preservation comparable with that of (a) many of the australites collected in larger numbers (over 2100) during the past 30 years in the Port Campbell district (Baker 1937, 1955) a few miles to the west, and (b) the australites (approximately 20) found in the Moonlight Head -Rivernook area nine miles to the SE. (Baker 1950). They have not been as severely weathered as the several hundred specimens found in the Stanhope's Bay-Childers Cove district (Baker 1956) 26 miles W. of Princetown, where abrasion as well as solution-etching has been effective. The specimens were donated to the National Museum of Victoria (Nos. E3958 to E3964) by Mr Franks in January 1965, and were submitted for examination and description per courtesy of the Assistant Director Mr E. D. Gill.

The discovery of these australites followed the opening up for closer settlement of the bush country N. and NW. of Princetown, where new access roads were constructed. The specimens were found on areas of grey sandy loam freed from vegetation by bulldozing on the new access roads. Some of the blocks of weathered rock exposed by these operations are Paleocene sedimentary types (sandstones to fine conglomerates). The area is 3½ to 4 miles E. of the E. limit of the Port Campbell concentration centre. Princetown township is 10-12 miles ESE. of Port Campbell township.

The only two other australites have been found in the area around Princetown, (1) a worn core portion of button from which the flange has been completely lost by erosion. It was located on a hardened soil surface exposed by sand-winnowing in the Recent sand dunes, approximately three-quarters of a mile E. of the mouth of the Gellibrand River and half a mile inland from the coast (Fig. 1). The site is about 8 miles S. of that of the australites collected by Mr Franks, and the specimen is also in the collection of the National Museum of Victoria (donated Mr T. Scott 2/1/63 reg. no. 2797), (2) a better preserved lens-shaped australite of specific gravity 2·463 from one mile NW. of Princetown township found on the side of the Great Ocean Road by a local resident and presented to the National Museum (reg. no. 2786) by Mr W. A. J. Saunders 12/12/62.

Fig. 1—Sketch map of Princetown area where australites were discovered (based on 1 : 31,680 Standard Series State Aerial Survey, Victoria. 933A—Princetown.)

The seven australites from the site six miles N. of Princetown township have been attacked by natural etchants (cf. Baker 1963a, pp. 4-6), some rather more extensively than others. A few have been subjected to processes of exfoliation (cf. Baker 1963b), more particularly the specimens listed in Table 1 as numbers 3, 7 (see Pl. 1, fig. J-L, S-U), evidently as a consequence of the effects of diurnal temperature changes accompanied by the effects of such processes as (a) differential expansion and contraction and (b) terrestrial solution etching along certain (often random) directions in the glass. None of the specimens, however, reveals signs of wear by abrasion, and in as much as certain aerodynamically produced features (Baker 1958) are still relatively well-preserved, no allowance can be made for a previous period of abrasion followed by subsequent terrestrial etching. Hence natural attrition by rolling during a period of transportation or by sand blasting during wind erosion can be eliminated from their history.

Even though there are only seven specimens in the collection made by Mr Franks, they nevertheless represent approximately 60% of the usual australite shapes found in other centres of greater numbers.

Dimensions, Weights and Specific Gravity Values

The dimensions, weights and specific gravity values of the seven specimens are listed in Table 1. These values do not apply to complete specimens, as can be judged from inspection of Pl. 1, hence the values for some of the dimensions and for all of the weights are lower than their original dimensions and weights at the time of earth landing. Fig. D-F on Pl. 1 represent the specimen nearest to a complete form. The shape types represented and the medium to small sizes are characteristic of the general run of specimens from the Moonlight Head-Port Campbell-Peterborough region.

The total weight of the seven specimens is 24·827 gms. For a range in weight of 0·658 gms to 13·272 gms shown in Table 1, the arithmetic average weight is 3·547 gms.

The specific gravity range is from 2·372 for the partially exfoliated flanged button to 2·467 for the round core, using deionized water at a temperature of 21·2°C. This range gives an average specific gravity value of 2·411, the same as that for 15 determinations of australites found nine miles SE. in the Moonlight Head district (Baker 1950, p. 35), and a little greater than the average (2·409) for 366 specimens from the Nirranda district to the W. (Baker 1956, p. 85). The average is higher than that for 555 specimens (2·397) from the Port Campbell region (Baker and Forster 1943) a few miles W. The differences between these average specific gravity values, and also the range in individual values, are within the compass of the figures obtained for over 1000 determinations (Baker 1956, Table VI, p. 90) from the spread of australites along the S. coast of Western Victoria. This covers a coastal strip from Moonlight Head at the E. end of the known area of distribution (Baker 1956, fig. 1) through Port Campbell, Peterborough, Flaxman's Hill and Stanhope's Bay, to Childers Cove nearly 40 miles W.

Usually flange fragments have a somewhat lower specific gravity than the core portions of australites, as seen from a large number of determinations for cores and flange fragments found separately and not known to have come from any one particular specimen in its more complete state (Baker and Forster 1943, p. 384, Baker 1944, p. 17). The same applies to a few specimens for which the specific gravity of the flange and core from the same specimen have been separately deter-

TABLE 1

Dimensions, weights and specific gravity values of australites from Princetown, Western Victoria

No.	Plate I, figure	Shape type	Diameter (mm)	Depth (mm)	Flange width (mm)	Length (mm)	Width (mm)	Weight (gms)		Specific gravity‡	
1	G to I	Small button with attached flange remnant*	11·0 (ex-flange)	6·5	4·7	—	—	Core	0·894	2·404	2·405
								Detached* flange fragment	0·357	2·405	
									1·251		
2	A to C	Small button with attached flange remnant	Core portion = 14·0	7·5	4·0	—	—	1·621		2·419	
3	J to L	Partially exfoliated flanged button	Core portion = 12·5; core plus flange = 20·0	10·1	3·5	—	—	2·152		2·372	
4	D to F	Flanged oval button with chipped flange†	—	9·0	4·0	23·5	20·6	Core with attached flange remnant	3·492	2·405	2·405
								First detached† flange fragment	0·553	2·402	
								Second detached† flange fragment	0·411	2·404	
									4·455		
5	M to O	Small oval	—	5·6	—	12·7	10·6	0·658		2·395	
6	P to R	Boat with attached flange remnant	—	6·0	4·3	Core portion = 17·2	Core portion = 10·8	1·419		2·418	
7	S to U	Round core	22·5	19·3	—	—	—	13·272		2·467	

* flange fragment became detached while cleaning specimen by ultrasonic techniques;
† one fragment of the flange became detached on cleaning, the other was detached when received for examination;
‡ $T_{H_2O} = 21 \cdot 2°C$.

mined (Baker and Forster 1943, p. 401). Less commonly, the specific gravity value of a flange can be greater than that of a core from which it was detached (Baker 1956, p. 85). Furthermore, as seen from Table 1, there is no significant difference in the specific gravity values for flange and core respectively of one and the same specimen for two of the examples listed (nos. 1, 4, Table 1). The same has been noted for a flanged australite button fragment from Nirranda, Western Victoria (Baker 1956, p. 86).

Such departures as these are not in accord with the earlier concept that flanges have lower specific gravity values than cores because of the loss of some of the heavier, more volatile constituents during aerodynamic ablation and the accompanying process of circumferential flange construction (cf. Baker 1956, p. 154). Evidently a process of differential volatilization during the phase of aerodynamic heating is not always responsible for producing flange glass of different specific gravity to that of the non-secondarily heated, primary core glass.

Descriptions of Specimens

In the following descriptions, the term 'anterior surface' refers to the surface that was directed forward down the flight path during hypersonic entry, and the term 'posterior surface' refers to the back surface that remained facing back along the flight path during high speed atmospheric transit (cf. Baker 1958, fig. 3, p. 379).

No. 1 (Table 1, Pl. 1, fig. G, H, I) is a small australite button with an attached flange remnant. The posterior surface of the core portion shows a rather vaguely defined flow swirl structure covering the greater part of the surface, and a few small, shallow pits up to 0·5 mm in diameter on the remainder of the surface. A little under one half of the flange remains on the specimen, and its posterior surface lies in an almost horizontal plane (cf. Baker 1944, fig. 2t) relative to the flight position (Pl. 1, fig. H), i.e. approximately normal to the flight direction. The posterior surface of the flange is slightly concave down the flight path, and minor amounts of terrestrial solution etching have brought out a series of concentric flow lines paralleling the inner and outer edges of the circumferential flange. The flange is relatively broad (4·7 mm wide as measured across the posterior surface) compared with the diameter (nearly 8 mm) of the posterior surface of the core exposed between the inner edges of the flange. The broken ends of the flange (see Pl. 1, fig. H) have been naturally etched to reveal the toroidal character and planar spiral arrangement of the internal schlieren (cf. Baker 1944, Pl. 1-3).

On the anterior surface, the first flow ridge (i.e. the ridge nearest the stagnation point in the front polar regions) is concentric in the ring-wave pattern and slightly oval in outline, measuring 7·5 mm by 8·5 mm across. Outwards from the first flow ridge, the second and third ridges are incomplete in continuity in the sense that they overstep one another in a radial direction (see top of photograph, Pl. 1, fig. 1), and hence they tend to be incipiently spiral in character. A shallow lunate depression 2 mm across which is slightly deeper towards the stagnation point side, occurs within the confines of the first flow ridge on the anterior surface, and is barely discernible in the right-central portion of the photograph (Pl. 1, fig. 1). It is situated half way between the front pole of the specimen and the first flow ridge, and is comparable with the dimple occurring in a similar position on a complete, oval-shaped, flanged australite from the Port Campbell district (Baker 1960, Fig. 1 B, C, p. 50, Pl. IX B). This is interpreted as a remnant of a small internal bubble

that became exposed and modified in shape by the progressive ablation and thin-film-melting of front surface tektite glass during the aerodynamic heating phase.

Several fine, radial flow lines trend across the anterior surface from near the stagnation point region to the equatorial regions of the specimen, being most pronounced where crossing the surfaces of the flow troughs in the ring-wave pattern (some of these flow lines are just detectible in Pl. 1, fig. 1). Their presence does not break the overall continuity of trend of the relatively sharp-crested flow ridges. Minute shallow pits averaging just under 0·25 mm across on the anterior surface, and situated more commonly in the area between the stagnation point and the first flow ridge, are a result of terrestrial solution etching.

No. 2 (Table 1, Pl. 1, fig. A, B, C) is an australite button with a small remnant of the flange still attached to the core portion. The posterior surface of the core reveals a relatively regular scatter of shallow pits that are evidently largely due to the effects of natural solution etching. These pits vary in diameter from approximately 0·25 mm to 1·0 mm. Few occur as isolated pits with regular, sharply defined edges. Most lie in close proximity to each other and are more irregular in outline and separated by slightly lower wall edges along their contacts. The posterior surface of the core shows no evidence of flow lines nor flow swirl structures as in specimen 1. About one-eighth of the circumferential flange remains attached to the central core portion (Pl. 1, fig. A). It shows the characteristic fracture pattern developed when a flange is detached in segments from the core by weathering agents. Fine concentric flow lines are discernible on its posterior surface by means of a X10 hand lens.

The contrasting anterior surface is virtually free from pits. It reveals a generally smoother surface surmounted by sharply defined elevations forming flow ridges, with the intervening flow troughs 1·5 mm to 2 mm wide. The first flow ridge outwards from the stagnation region is concentric, slightly oval in outline, and measures 8 mm by 9 mm across. The second flow ridge measures 12 mm by 12·5 mm, and its trend on the curved anterior surface is clockwise spiral (Pl. 1, fig. C). The ridges and troughs constitute the ring-wave patterns of aerodynamic origin which are so well displayed on the better preserved specimens. Finely sculptured flow lines pass radially outwards from the front polar regions, cross the surfaces of the flow troughs (Pl. 1, fig. C), and terminate at the broken edges of the specimen in the equatorial regions. Compared with specimen 1, the flange is narrower (4 mm wide) relative to the diameter of the core surface (12 mm) exposed within the inner edges of the (reconstructed) circumferential flange.

No. 3 (Table 1, Pl. 1, fig. J. K, L). This is a partially exfoliated flanged button that was evidently originally round in plan aspect but is now oval in outline (Pl. 1, fig. J, L) due to approximately equivalent amounts of spallation of the glass from two diametrically opposed sides of the specimen. The posterior surface reveals a number of etch pits in places, but elsewhere, such as on lower levels arising from removal of thin flakes by exfoliation, subsequent terrestrial solution etching has accentuated the complex pattern of internal schlieren in the sub-surface regions of the glass. The etch pits average 0·3 mm to 0·4 mm in diameter.

Approximately one-fifth to one-quarter of the circumferential flange remains attached to the core of the australite as two separate portions on diametrically opposed parts of the circumference of the specimen (Pl. 1, fig. J, K). Natural etching of the broken surfaces of the flange, as viewed in side aspect (Pl. 1, fig. K) has accentuated the remarkably well-developed toroidal character of the inrolled schlieren in the glass constituting this secondary, aerodynamically produced struct-

ural feature. In the chin regions (cf. Baker 1944, p. 8) of the flange, the schlieren reveal some contortion and puckering which were evidently due to the jamming of warmer against cooler glass during a phase of flange construction. As exposed on the posterior surface of the flange, the flow lines constituting the toroidal schlieren outcrop (on natural etching) as a series of fine concentric flow lines. The flange is somewhat narrower (3·5 mm wide) relative to the diameter of the core surface (12·5 mm) exposed between the inner edges of the circumferential flange, in comparison with specimens 1 and 2. The relationships of flange width to core diameter for specimens 1 to 3 are shown in Table 2.

TABLE 2

Relationships of flange width to diameter of core exposed between the inner edges of the flange for three round australites from Princetown

No. in Table 1	Flange width (mm)	Core diameter (mm)	Ratio flange width: core diameter
1	4·7	8·0	0·59
2	4·0	12·0	0·33
3	3·5	12·5	0·28

The trend in Table 2 is for the ratio of the flange width to the core diameter to decrease in value with increase in size of the specimen. This is evidently a reflection of the relative amount of flange glass re-frozen in the equatorial regions of secondary forms produced by aerodynamic ablation of small spheres of tektite glass with originally somewhat different radius, giving a generally broader flange from originally smaller spheres. Unlike specimen 1, the posterior surface of the flange in specimen 3 is somewhat rounded down the flight path (Pl. 1, fig. K) and dips inwards at an angle of just under 10° to the horizontal plane of the specimen (cf. Baker 1944, fig. 2g, h). The flange posterior surface in specimen 2 likewise dips inwards (Pl. 1, fig. B) in contrast with that of specimen 1. The reasons for this variation in angle and curvature of the flange posterior surface have yet to be interpreted in detail in terms of the aerodynamic turbulence which moulds the flange glass into its toroidal, circumferential form.

The flow ridges on the anterior surface of specimen 3 are somewhat irregular in trend, but are generally counterclockwise spiral in character (Pl. 1, fig. L). The first ridge measures 8·5 mm by 10 mm across. The degree of vitreous lustre of the anterior surface is somewhat higher than on the other six specimens in this collection of australites from N. of Princetown. In view of the presence of finely marked radial flow lines trending outwards on the anterior surface from the stagnation region to the periphery of the specimen, and the probability that such flow lines become accentuated by terrestrial solution etching, it is considered that the highly vitreous lustre of the anterior surface is not so much indicative of preservation of the outermost layer of aerodynamically heated glass as an expression of the effects of etching. No doubt a fraction of a millimetre of such glass has been removed by sub-aerial agencies since the time the specimen landed on earth a few thousand years ago. A few minute etch pits on the anterior surface (Pl. 1, fig. L) average between 0·1 mm and 0·2 mm in diameter, while a larger, shallow etched-out 'crater' measuring 3 mm by 2 mm in size is located between the first and second flow ridge. The floor of this 'crater' is covered with micro-etch pits.

Examination of the naturally etched exfoliation surfaces in side aspects of the specimen (e.g. Pl. 1, fig. K) reveals that the thickness of the sub-surface shell of aerodynamically heated glass on the anterior surface of the tektite ranges from 1·9 mm in the stagnation region (i.e. at the front pole of the specimen at the bottom of Fig. K in Pl 1) to 2·7 mm at the contact between the central body portion and the circumferential flange in the equatorial regions of the specimen (i.e. left-hand and right-hand portions of Fig. K, Pl. 1). The surfaces exposed by exfoliation have been significantly affected by terrestrial solution etching, and they now reveal the intricate internal flow line pattern of the core glass and of the glass constituting the aerodynamically heated outer shell. The line of contact between the heated shell of glass on the anterior surface and the inner core regions to which heating did not effectively penetrate, is relatively well defined in Pl. 1, fig. K. The rather irregular nature of the line of contact is principally, if not entirely, an outcome of slight variability in the degree of attack of subsequent terrestrial etching processes. Further spallation and etching subaerially of a weathered specimen such as that represented by Pl. 1, fig. J, K, L, ultimately leads to complete removal of the flange glass and of the anterior surface heated shell glass, leaving the more stable core portion which usually is of conical shape and reveals a flaked equatorial zone like that depicted in Pl. 1, fig. T.

No. 4 (Table 1, Pl. 1, fig. D, E, F), is a flanged oval-shaped australite in plan aspect with a slightly chipped circumferential flange. It is the best preserved specimen in the collection. Although oval and having the longer diameter 3 mm greater than the shorter diameter (cf. Pl. 1, fig. D, F), the flange width remains constant at 4 mm, apart from minor irregularities around the outer edge of the specimen.

The posterior surface of the core is covered with minute pits averaging 0·2 mm to 0·3 mm across and ranging in outline from sub-circular to elliptical, and occasional indistinct grooves where etch pits have merged into one another. The posterior surface of the flange is in marked contrast to that of the core, being generally smooth and revealing only a few shallow micro-pits mostly under 0·1 mm across and one larger pit nearly 1 mm in diameter (Pl. 1, fig. D, left side). This larger pit is evidently a small bubble that burst at a late stage of the atmospheric phase of the australite, or else its thin upper wall has been penetrated during weathering while the specimen rested on the earth's surface. The bulged up glass extending circumferentially around the pit opening for nearly 0·5 mm around its edge, indicates conclusively that this is truly a bubble remnant and not due entirely to subsequent terrestrial solution etching. A number of similar, small, burst bubbles have been noted previously on the posterior surfaces of australite flanges (Baker 1944, p. 9), but very few remain unburst. One such bubble has been figured adjacent to a burst bubble (Baker 1946, Pl. XII, fig. 15) on a flange fragment from the Port Campbell district. The pressure and composition of the gas in such small bubbles is unknown. In view of the circumferential flange structure on australites being generated as a secondary feature from aerodynamic heating during hypersonic transit through the earth's atmosphere, any gas included in such small bubbles is likely to be either entrapped air, or vapours outgassed from melting tektite glass, or both. The inner walls of the pit reveal glass with a higher degree of vitreous lustre than the surrounding glass, but because of some initial attack by terrestrial etchants which have had access to the pit, the lustre is not as brilliant as shown by the 'hot polish' (cf. Baker 1959a, Pl. XIV, fig. 2) of the interior of newly opened tektite bubbles (hollow tektites). Fine concentric flow lines trending parallel with

the outer and inner edges of the circumferential flange are in places interrupted by the micro-etch pits on the posterior surface.

The first flow ridge on the smoother anterior surface of the specimen is oval, concentric, and measures 10 mm by 12 mm across. The subsequent flow ridge is counterclockwise spiral (Pl. 1, fig. F). Fine radial flow lines extend from the stagnation point region outwards to the equatorial edges of the specimen. They are mostly too fine to be readily detectible at the magnifications of Pl. 1, fig. F. Where these flow lines encounter a cavity 1·5 mm across at the edge of the first flow-ridge (Pl. 1, fig. F, right side), they are arranged in an anticlinal (saddle-like) pattern with the apex of the anticline directed towards the stagnation region of the specimen. Although this cavity, which is round in plan, may have been a little overdeepened and broadened by slight terrestrial solution etching, its origin seems to be fundamentally one of exposure of an internal bubble at the particular level reached during the final stages of ablation-reduction of the forwardly directed surface during atmospheric flight. It is slightly deeper towards the stagnation region and the 'anticlinal' appearance of the adjacent flow lines indicates streaming of non-homogeneous glass around the internal bubble in the primary phase of tektite formation.

Another pit 1·25 mm in diameter on the anterior surface is located towards the other end of the specimen between the first and second flow ridges. It is unusual in containing a small pyramid of tektite glass, broader at the base and projecting up from the bottom of the pit almost to the level of the lip of the pit opening. This pyramidal or conical projection of glass measures approximately 0·3 mm across at its summit, the surface of which is slightly concave and hence 'crater-like'. The origin of this feature is uncertain, and although its present overall appearance may have been modified somewhat by the tertiary process of terrestrial solution etching, there is nothing evident to disprove an origin during the primary and/or secondary phases (cf. Baker 1963a) of formation. A similar pit with a central core of glass is shown in a thin section of a flanged button from Port Campbell (Baker 1944, Pl. 1, fig. 4).

Very few micro-pits under 0·1 mm diameter occur on the otherwise smooth anterior surface, and a few occur on the walls of the small bubble cavity exposed by ablation. The lip of this cavity, on the side remote from the stagnation region, is interrupted by five small pits of circular outline and approximately 0·1 mm across, while a string of four smaller pits, closely spaced and in line, lead away from the edge of the cavity and trend across the surface of the flow trough situated on the side of the cavity nearer the periphery of the specimen. These are probably micro-etch pits and due to the tertiary process of terrestrial erosion.

No. 5 (Table 1, Pl. 1, fig. M, N, O) is a small oval from which the flange has been completely removed by erosion and the flange band, which is approximately 2 mm wide, has been corroded by soil etchants. The flange band is usually smooth-surfaced on relatively recent exposure and it represents the circumferential plane of contact between the flange and the core in the complete flanged australites (Baker 1944, p. 8; 1959b, p. 76). The oval shape of the specimen is rather accentuated by the way it has weathered (Pl. 1, fig. O), but its original outline in plan is confirmed as oval from the measurements (7·5 mm by 9 mm) of the core surface within the confines of the etched flange band (Pl. 1, fig. M). The posterior surface of the core is minutely pitted and roughened from terrestrial solution-etching, whereas the flange-band shows a somewhat different etch pattern due to the presence of short, shallow, but rather ill-defined solution grooves (Pl. 1, fig. M, right end) and a few larger, shallow pits.

A few micro-pits averaging 0·2 mm across occur on the otherwise smooth anterior surface which has a counterclockwise spiral flow ridge. A relatively large concave, shallow facet (just distinguishable on fig. N, O, Pl. 1) on one side of the anterior surface, evidently marks the site of an internal bubble which became exposed and nearly obliterated by the process of aerodynamic ablation. The concave facet measures up to 5 mm across and 4 mm deep. It is slightly deeper and narrower (3 mm across) nearest the stagnation point where it tends to be lunate in outline. From this region it flattens and broadens (to 5 mm across) at its edge remote from the stagnation point. Since it lies across the ring-wave pattern of flow ridge and flow troughs on the convexly curved anterior surface, it has caused the flow ridge to pass from a rather poorly-defined 'initial hump' 4 mm in diameter in the stagnation point region, to a counterclockwise spiral, relatively sharp-crested flow ridge. This flow ridge descends around the curved anterior surface from near the top edge of the facet to the periphery of the specimen where it forms the broader edge of the facet. Radial flow lines cross the ring wave pattern and extend from the stagnation point in the front polar region outwards to the equatorial edge of the specimen.

The specimen reveals a marked difference between the arcs of curvature of the posterior and anterior surfaces respectively (see 5, Table 3). As seen in side aspect, the posterior surface has a much larger radius of curvature and hence is much flatter than the anterior surface which is rather steeply curved (lower surface of fig. N, Pl. 1) for a relatively small specimen. Since the curvature of the posterior surface is more or less that of the original australite spheroid, while the anterior surface is a product of the secondary process of aerodynamic ablation, the indication is that for its size this specimen suffered rather more ablation than other primary australite spheroids (cf. 4, 5, 6, Table 3).

No. 6 (Table 1, Pl. 1, fig. P, Q, R) is a small boat-shaped australite with portion of the circumferential flange preserved as an attached remnant along one side of the specimen; the remainder of the flange has been lost by terrestrial weathering. The sculpture pattern of the posterior surface of the core of the specimen is dominated by closely crowded pits 0·15 mm to 0·5 mm across. The pits cover all but the central portion of the core surface, while the central portion is constituted of a small flow swirl 3·5 mm by 4 mm in area. This swirl (Pl. 1, fig. P) is a somewhat smoother, slightly oval patch on the surface marked by partially etched-out flow lines. Immediately adjacent to the swirl, terrestrial solution-etching has overdeepened the neighbouring pits, causing this part of the surface to become ragged in appearance and more roughened (see black area surrounding the flow swirl in fig. P, Pl. 1). In marked contrast, the posterior surface of the attached remnant of the circumferential flange is considerably smoother (Pl. 1, fig. P) and reveals only a few shallow, minute pits and occasional flow lines. In cross-sectional aspect, the weathered broken ends of the attached flange remnant show the toroidally inrolled character of its internal schlieren pattern.

On the diametrically opposite side to the attached flange remnant, and also at each end of this elongated australite, a relatively smooth-surfaced flange band (just visible above the rim of the specimen in Pl. 1, fig. Q) marks the original position of attachment of the circumferential flange to the core. The flange band measures 1·0 mm to 1·5 mm in width. The fact that its surface is little etched and dulled in lustre, indicates that the missing portions of the circumferential flange have not been detached for any length of time compared with other australites on which the flange-band surface is more weathered. The smoother anterior surface is marked by a pattern of radial flow lines (Pl. 1, fig. R), one incompletely preserved

concentric flow ridge, a few micro-pits, a crater-like pit 2 mm across which was evidently caused by overdeepening on terrestrial solution-etching, and a pit at one end (left-hand side of fig. R, Pl. 1) measuring 1·0 mm by 1·5 mm across which is regarded as a small internal bubble exposed as a pit on the forwardly directed surface of the specimen by progressive thin film ablation.

No. 7 (Table 1, Pl. 1, fig. S, T, U) is the largest specimen in the collection and is designated a round core. The posterior surface reveals two large excellently developed flow swirl structures in the sculpture pattern, and a few micro-pits ranging from 0·1 mm to 0·75 mm across. These swirls measure 11 mm by 16 mm and 9 mm by 19 mm across, but the larger swirl is transected at the edge of the specimen as a consequence of terrestrial erosion. Smaller flow-swirled areas adjacent to the two larger swirls are less defined and show more complexly folded flow line trends. Each swirl structure is constituted of patches of glass with numerous fine flow lines arranged in crudely concentric to complexly contorted (fold-like) fashion. They have been accentuated by a small degree of differential solution etching. This has produced the effect of some schlieren being represented by long, narrow ridges slightly raised above the general surface of the glass, while others are long, narrow grooves depressed below the general level of the swirl structures. These fine grooves are seldom as deeply etched-out as the majority of the micro-pits. Some of the micro-pits lie athwart the trends of the miniature ridges and grooves in the flow-swirled areas, without offsetting their trends in any way, while others occur on the smoother (less flow-lined) parts of the flow-swirl structures.

A feature seldom noted on flow swirl patterns generally is that in addition to such positive and negative features as the elevations forming micro-ridges and the elongated depressions forming micro-grooves, the micro-pits also have a counterpart in the form of slightly elevated, sub-circular to oval-shaped micro-mounds. One such micro-mound measuring 0·5 mm by 0·75 mm occurs on the surface of the larger of the two biggest flow swirls. Another approximately 0·2 mm across occurs on the surface of one of the smaller flow swirls. Two others of rather irregular shape occur on the surfaces of other flow swirls. A few appear on the etched anterior surface while rare examples are noted on the etched surface of the flaked equatorial zone shown in Pl. 1, fig. T. These are evidently small nodes of different composition in the flow line pattern. They have remained rather more resistant to terrestrial etchants than the surrounding glass and that in the micro-ridges, while all of these three features are evidently constituted of tektite glass that is significantly more resistant to etching than that of the micro-grooves and micro-etch pits. There is no observable colour difference between these features in the hand specimen, but thin section studies indicate that chemically significant differences occur, the positive features such as the micro-ridges and micro-mounds being evidently richer in silica and slightly more resistant to soil etchants.

The anterior surface of this core reveals no remnants of the secondarily developed aerodynamic sculpture pattern so conspicuous on more completely preserved australites. This is because the thin outer zones of aerodynamically heated glass have been removed by terrestrial erosion. The specimen reveals an excellent pattern of complexly contorted flow lines because solution-etching has exposed and accentuated the internal schlieren in the sub-surface regions of the australite. Cutting across and sometimes parallel with the flow line trends are a number of solution gutters (Pl. 1, fig. U) which are much deeper and wider than any of the micro-grooves in the flow-swirl patterns appearing on the posterior surface. Exfoliation of glass from the anterior surface of this core has been most pronounced in the peri-

meter regions of the specimen. This is a consequence of terrestrial erosion and has resulted in the development of a marked circumferential flaked equatorial zone that is 11 mm to 12 mm deep and strongly etched to reveal the complicated nature of internal schlieren in the sub-surface glass of the core.

Curvature of posterior and anterior surfaces

The curvatures of the posterior and anterior surfaces of the specimens have been determined graphically from magnified silhouettes (Baker 1955, 1956). The radii of curvature determinations for the round forms of australites from north of Princetown, and for directions normal to the long axes of the elongated specimens, are set out in Table 3. From this table it can be seen that the largest round specimen (7) in the collection resulted from the aerodynamic ablation of the largest primary sphere (3·7 cm diameter) while the average size primary sphere for the remaining round forms (1-3, Table 3) was approximately 1·6 cm in diameter.

TABLE 3

Radii of curvature determinations, Princetown australites

No. (cf. Table 1)	R_B (mm)	R_F (mm)	Diameter of primary sphere (mm)
Round Forms			
1	8·8	7·6	17·6
2	7·7	8·9	15·4
3	7·4	10·9	14·8
7	18·6	14·2*	37·2
No. (cf. Table 1)	**R_B (mm)**	**R_F (mm)**	**Diameter of primary ellipsoid (mm.)**
Elongated Forms†			
4	12·6	11·6	25·2
5	9·4	5·9	18·8
6	6·3	7·2	12·6

* Anterior surface significantly modified by terrestrial exfoliation and solution-etching.

† Determinations made across shorter diameter.

Sculpture Patterns arising from Natural Solution Etching

In as much as the australites from N. of Princetown reveal a variety of well-developed sculptural elements arising from the attack to different degrees by soil etchants, the results of the etching process are summarized below and subsequently further elaborated:

1. Accentuation and/or development of small surficial pits on the posterior surfaces of the body portions of many of the specimens (Pl. 1, fig. A, D, G, M, P), and of the schlieren constituting flow swirls on others (Pl. 1, fig. P, S).
2. Exposure of the generally concentrically trending flow lines on the posterior surfaces of the circumferential flanges but with the concomitant development of very few micro-etch pits compared with their frequency on the posterior surface of the core.
3. Accentuation of the internal inrolled schlieren in toroidal flanges generally broken across in more or less radial directions (Pl. 1, fig. H).

4. Exposure of the complex internal flow line patterns within central body portions as a consequence of attack by terrestrial etchants on surfaces exposed by terrestrial exfoliation (Pl. 1, fig. K, T).
5. The development of deeper grooves as gutter-like structures trending largely across the patterns of schlieren on etched surfaces exposed by exfoliation, more especially on the anterior surface of the australite round core specimen (Pl. 1, fig. U) which is larger than any of the other forms.
6. The production of circular pits and accentuation of the complex internal flow line pattern on the spalled surfaces of the flaked equatorial zone of the core specimen (Pl. 1, fig. T).
7. The formation of low micro-ridges and micro-mounds of rather less readily etchable glass as infrequent features (seen only in the core specimen 7).

Furthermore, the exfoliation processes have assisted in the spallation and shedding of segments of outer zone glass from some specimens (cf. Pl. 1, fig. J, L) as evidenced by specimen 4 (Table 1) which shows narrow 'crack-like' features (cf. Baker 1944, p. 12) that cut across the posterior surface of the circumferential flange in three places (Pl. 1, fig. D). Before this specimen (4, Table 1) was cleaned by ultrasonic techniques to remove soil particles, the narrow, 'crack-like' features contained partially cemented soil constituents and possibly some residual alteration products formed during dissolution of the glass from the 'cracks'. The removal of the terrestrial materials by ultrasonic vibration in 1 : 1 cold HCl resulted in segments of the flange parting from the equatorial edges of the central body portion of the specimen. Inspection of the cleaned walls of the 'cracks' under low power lenses of a binocular microscope revealed that differential natural solution-etching had advanced to such a degree as to bring out the toroidal character of the internal schlieren in the circumferential flange. The detached portions fitted together relatively well (Pl. 1, fig. D-F), but in places, open 'cracks' (grooves and gutters) remained where some of the glass had been completely removed by solutions.

It is still unknown as to precisely how such 'cracks' were initiated and what controlled the directions they followed on the curved surfaces and into the interior of the australites. On the circumferential flanges they usually cut normally to or obliquely across (i.e. more or less radially) the external and internal structures of the flanges (see Pl. 1, fig. A, G, J, P). On the cores of the australites they wander over the curved surfaces and sometimes penetrate deeply into the interior zones of the glass objects, frequently following quite random directions. Elsewhere in the literature, comparable but generally shallower features have been referred to as 'saw-marks' and 'saw-cuts' (cf. Baker 1959, p. 40), and deeper structures as gutters or gouttières (Baker 1959, p. 39).

In view of the major rôle played by natural (terrestrial) solution etching in destroying the primary (extraterrestrial) and secondary (aerodynamically produced) features of australites, the crack-like structures are not to be regarded as true 'cracks' in the sense of being contraction cracks or impact-induced cracks. Rather are they to be explained as narrow, sometimes shallow, sometimes deep, solution grooves developed as a consequence of the biochemical reactions occurring in soils. The concept is that the 'crack-like' features were initiated after the specimens landed on the earth's surface. They are certainly not primary features because they occur on the secondarily produced aerodynamic structures. Neither were they formed as aerodynamic features during earthward flight, because they show no

relationship to the established aerodynamically produced features on the anterior surfaces of australites; they often cut randomly across all features such as the flow ridges and flow troughs constituting the ring-wave pattern, as well as across the circumferential flanges. After landing on the earth's surface, terrestrial erosion principally affected the strained tektite glass constituting the aerodynamically formed anterior surface zone and the circumferential flange (cf. Baker 1963a, fig. 1), but in several specimens the process of dissolution continued beyond the strained zones into the primary core glass. In view of the fact that the specimens occurred within the root zone of the soils from which they were recovered, emphasis must be placed on the rôle of the soil biota and the roots of grasses and other vegetation in etching and dissolving tektite glass. The potency of the biochemical reactions arising from such an association is paralleled by the effects that lichens and mosses have in the etching and weathering of the exposed surfaces of many and varied types of rocks. The trends of the solution gutters in australites showing these features may well be controlled by the directions of rootlets growing around them. In substantiation of this concept is the observation that soil constituents occupy the gutters in specimens recently released from soils, and that two of the specimens recently collected north of Princetown and another from the Port Campbell district contained rootlets in the soil constituents occupying the gap region near the core-flange boundary and in the soil continuing down into the deep gutters. In course of time the soil constituents may ultimately become partially cemented to the walls of both deep and shallow gutters (cf. Baker 1944, Pl. 1, fig. 2, 4), and are then no longer suited to root access. The process of glass dissolution continued gradually during over-deepening of the initially shallower etched out gutters, accompanied by progressive infiltration of soil constituents.

Following cementation of soil constituents in the 'cracks' (gutters) and exposure of some australites in areas subject to minor amounts of soil deflation, it is apparent that differential expansion and contraction between the walls of the gutters and the contained soil constituents, would (as a consequence of diurnal temperature changes) contribute substantially to the disintegration of such australites. Fragments of australites have been found with soil constituents still firmly attached by cementation to one or other of the gutter-walls. The nature of the cementing medium varies with locality and degree of soil leaching. In some areas the cement is dominantly ferruginous (limonitic), elsewhere it is siliceous. In some the matrix is largely argillaceous, relatively well compacted, and ranges in colour from brown to white. Sub-angular and sub-rounded to rounded grains of quartz are commonly embedded in the fine-grained matrix.

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Description of Plate

Plate 8

Australites from N. of Princetown, Western Victoria. A-U × 2. (In all photographs of side aspects, the posterior surface is at the top.)

A-C. Small button with flange remnant. A—posterior surface. B—side aspect. C—anterior surface showing first flow ridge concentric and subsequent flow ridge clockwise spiral; flow lines radial.

D-F. Flanged oval form. D—posterior surface showing pitted core and smoother circumferential flange with pit representing a burst bubble at left-hand end. E—side aspect showing flow ridges on anterior surface. F—anterior surface showing first flow ridge concentric and interrupted (right side) by an exposed internal bubble pit; subsequent flow ridge counterclockwise spiral (in E the core does not appear above the edge of the flange).

G-I. Small button with nearly half of flange preserved. G—posterior surface showing pitted to flow lined core and smoother circumferential flange. H—side aspect showing toroidal incoiling of internal flow lines of flange brought out by weathering of the fracture surfaces. I—anterior surface showing concentric flow ridges.

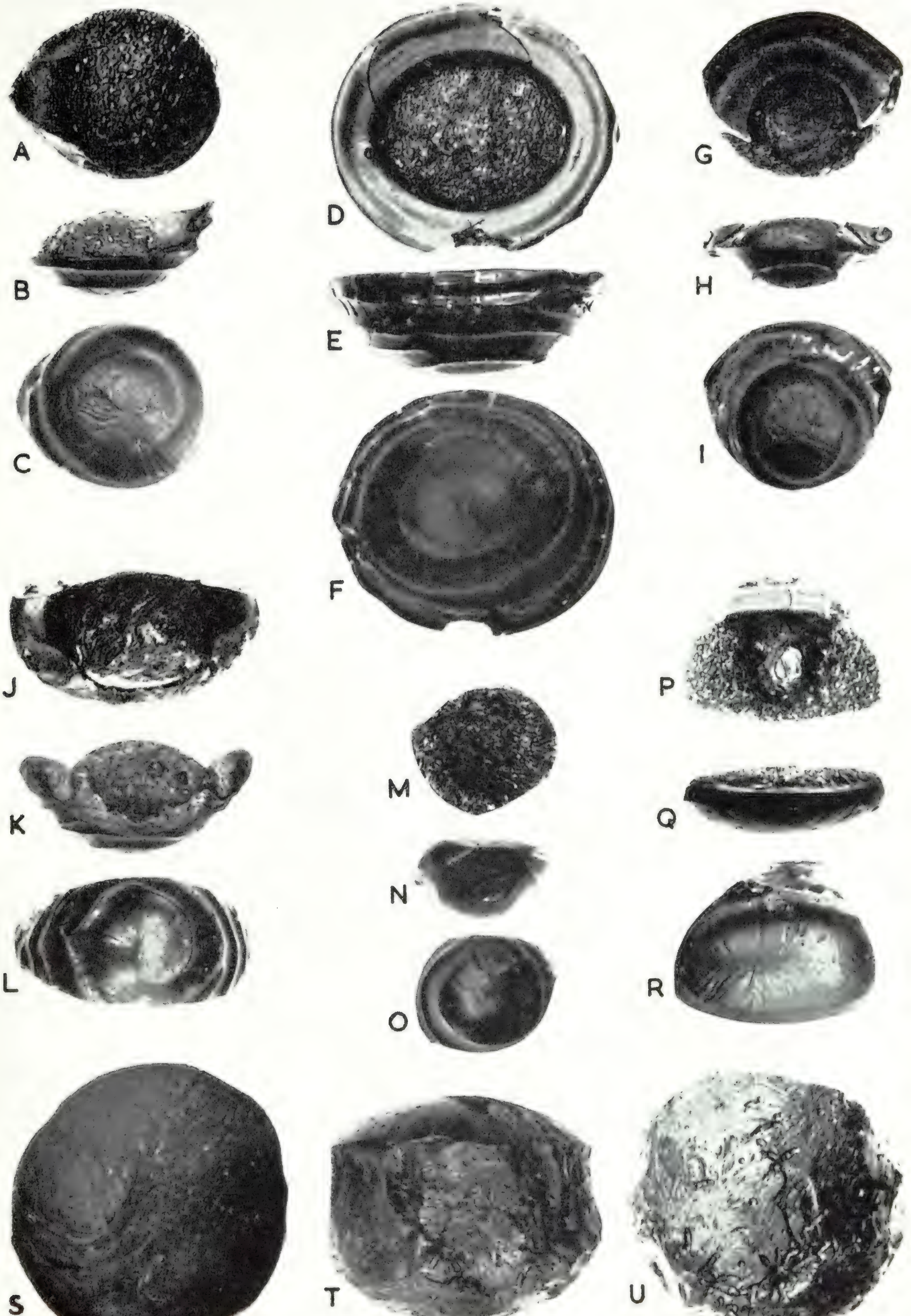
J-L. Partially exfoliated flanged button. J—posterior surface with core showing etch pattern of flow lines and occasional pits. K—side aspect showing central core marked off by spallation from the aerodynamically strained front surface glass (bottom of photograph). L—anterior surface with counterclockwise spiral flow ridge and radial flow lines.

M-O. Small oval without flange. M—posterior surface much pitted from (terrestrial) solution-etching. N—side aspect. O—anterior surface with counterclockwise spiral flow ridge and facet (top of photograph).

P-R. Boat-shaped form with attached flange remnant on one side (top of photograph P). P—posterior surface showing etch-pitted core and remnant of flow swirl structure (in central portion of photograph), flange relatively smooth. Q—side aspect showing smoother 'flange band' representing position from which the flange was detached during a late stage of weathering. R—anterior surface with concentric flow ridge and radial flow lines.

S-U. Round core with flaked equatorial zone. S—posterior surface showing pattern of flow swirls. T—side aspect showing nature of flaked equatorial zone (11-12 mm wide); flow lines common, few pits. U—anterior surface with flow lines, pits, and short gutters; no flow ridges are shown on this form because exfoliation of the outer zone of the anterior surface has occurred.

(Photographs by Mr R. K. Blair)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AUSTRALITES FROM NNE. OF MORGAN, SOUTH AUSTRALIA

By GEORGE BAKER

Introduction

From an area of approximately one mile in extent, situated 16 miles NNE. of Morgan, South Australia, 148 australites were collected by the late Mr Benjamin Thamm and Mrs Doris Thamm between 1924 and 1928. The specimens were made available for study by Mrs Thamm in 1964 through the courtesy of Mr R. Seeger, and are said to be representative of the australites occurring in this area. They are now registered as numbers E3965-E3992, E3994-E4113 in the National Museum of Victoria.

The specimens were discovered on relatively bare areas in flat grazing country where some soil deflation had occurred, and were exposed at the surface of the ground on patches of hardened sandy soil with associated light-brown and brownish-red to red loam. The most fruitful searching periods are reported by Mrs Thamm to have been in dry windy weather. Specimens were located during relatively frequent traverses across the bared areas, and usually occurred with the anterior surface facing upwards. The author is indebted to Mrs Thamm and her brother, Mr Waldron, for information relating to the specimens.

Morgan is situated at the junction of Burra Creek and the Murray River, on the 'Northwest Bend' of the Murray, at approximately 140°E. and 33°30'S., 90-100 miles NE. of Adelaide. The soils from which the australites were released occur on Tertiary sediments that form part of an inland basin.

Australites subjected to a comparable degree of weathering and with different proportions of shape types were found between 1936 and 1940 in this general region at Florieton on Burra Creek some 20 miles NW. of Morgan (Mawson 1958) where they occurred under similar conditions, the areas being soil-deflated patches in a semi-arid region originally cleared and ploughed for growing wheat and later utilized for sheep grazing.

Two other specimens included with the Thamm collection of australites are black in colour, dense in texture, but not glassy like the australites; they resemble black lydianstone. One is small, rounded, sub-spherical and measures 5 mm $\times$ 4·5 mm $\times$ 3·5 mm. The other is larger, elongated, and is a ventifact with four facets cut and shaped by windblown sand. One facet is larger and one smaller than two of intermediate size, and the specimen measures 38 mm $\times$ 10·5 mm $\times$ 9·5 mm. Stones of this size, shape and colour have frequently been mistaken for australites.

Dimensions, weights and specific gravity values

The dimensions, weights and specific gravity values of the 148 australites constituting the Thamm collection are set out in Table 1. The specific gravity values were determined by weighing each thoroughly cleaned specimen in air and deionized water (T = 18°C.) on an air-damped chemical balance. Ranges in values and average values for these properties are brought together in summarized form in Table 2. The least weight of 0·314 gms (Table 1, 120) was for a small oval (Pl. 10, fig. 34), and the greatest weight of 72·349 gms (Table 1, 1) for a large core (Pl. 10, fig. 2). The lowest specific gravity (Table 1, 98) was for a large teardrop

(Pl. 12, fig. 27), and the highest (Table 1, 132) for a canoe-shaped-shaped form (Pl. 11, fig. 32-34). From the specific gravity-silica content relationships of tektites (Baker 1959a, Fig. 13), the range in specific gravity of the Morgan australites points to a range in silica content of 71·5% to 79·5%, with an average of 74·5%.

The frequency distribution of the 148 specific gravity determinations is given in figure 1.

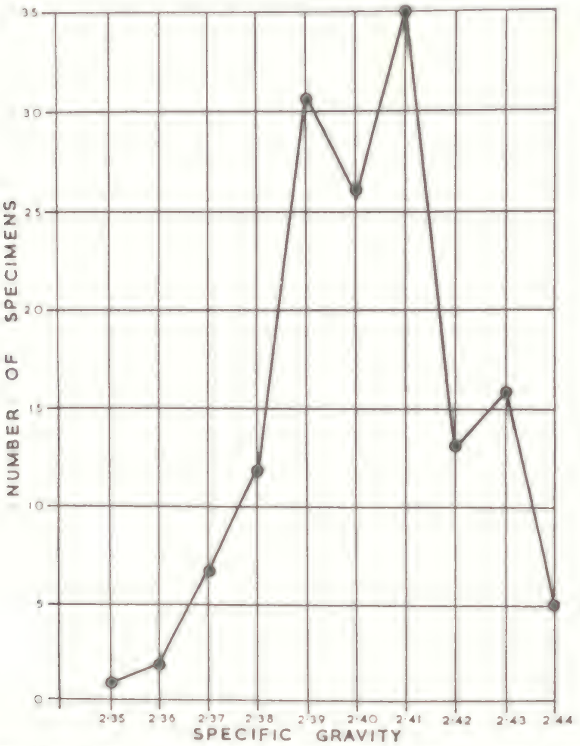

FIG. 1—Frequency polygon showing distribution of specific gravity values for 148 australites from near Morgan, South Australia. The arithmetic mean of the specific gravity values is 2·405.

In as much as the silica content of australites varies inversely as the specific gravity, with the lower specific gravity values indicating glass rather richer in SiO_2, the average values for the specific gravity of the various shape types shown in Table 2 point to the groups of the lenses, boats, teardrops and most of the dumbbells being rather more acidic than the groups of the round cores, ovals and canoes. This contrasts with the australite shape types from Mulka, where the average specific gravity values indicate that most ovals, canoes and teardrops are rather more acidic than the lenses, boats, dumbbells and round cores (Baker, in press). Since average values are under consideration, the variations shown are more likely due to chemical variations than to changes in small gas bubble contents from shape group to shape group.

Comparison of australite shape type percentages and weights from near Morgan, from Florieton, and from Mulka, S.A.

On the grounds that the numbers of specimens classifiable into specific shape types for the australites from the Morgan district and from Florieton respectively

TABLE 1

Dimensions, weights and specific gravity values of 148 australites from Morgan, S.A.

	Collection Number	Shape Type	Diameter (mm)	Depth (mm)	Length (mm)	Width (mm)	Flange width (mm)	Weight (gms)	Sp. gr.
4 Buttons (2·7% total)	111	Flanged button (round in plan)	20·2	9·0			2·6	3·349	2·403
	117		14·9	6·6				1·588	2·389
	119		12·6	6·0				1·027	2·410
		Average	15·9	7·2				1·288	2·401
	112	Hollow button (broken)	22·5 (ex-flange)	10·6+ (back surface broken)				4·045	2·411
2 Lenses (1·3%)	116	Lens	16·9	7·4				2·275	2·400
	138	Lens	16·4	8·2				2·212	2·392
		Average	16·7	7·8				2·234	2·396
44 Round cores (29·7%)	2	Round core	36·5	24·8				39·671	2·393
	4	,, ,,	34·2	27·8				41·831	2·409
	5	,, ,,	32·0	26·1				33·981	2·413
	6	,, ,,	32·4	24·2				34·137	2·430
	8	,, ,,	24·3	19·2				12·481	2·383
	9	,, ,,	23·5	21·4				15·312	2·424
	10	,, ,,	24·7	17·5				13·426	2·422
	11	,, ,,	24·7	16·5				12·253	2·413
	12	,, ,,	23·4	18·6				11·995	2·405
	13	,, ,,	23·2	17·3				11·371	2·419
	14	,, ,,	24·0	16·0				9·531	2·388
	15	,, ,,	21·8	17·8				10·088	2·411
	16	,, ,,	22·4	16·1				8·690	2·370
	17	,, ,,	21·5	14·6				8·329	2·413
	18	,, ,,	20·2	18·7				9·945	2·406
	19	,, ,,	20·8	16·2				9·501	2·417
	20	,, ,,	21·0	17·1				9·371	2·435
	21	,, ,,	20·9	16·4				8·846	2·410
	22	,, ,,	20·4	16·2				9·172	2·428
	23	,, ,,	20·1	15·1				7·430	2·414
	24	,, ,,	22·0	13·9				8·135	2·405

TABLE 1 (*continued*)

	Collection Number	Shape Type	Diameter (mm)	Depth (mm)	Length (mm)	Width (mm)	Flange width (mm)	Weight (gms)	Sp. gr.
44 Round cores (29·7%) (continued)	25	,, ,,	21·7	15·3				8·788	2·412
	26	,, ,,	22·9	13·0				8·525	2·414
	27	,, ,,	21·4	12·3				7·556	2·436
	28	,, ,,	19·6	12·8				6·507	2·424
	29	,, ,,	20·5	15·3				6·191	2·369
	30	,, ,,	18·9	12·8				5·213	2·396
	31	,, ,,	19·2	11·7				5·451	2·392
	32	,, ,,	19·2	12·3				5·505	2·405
	33	,, ,,	16·6	15·5				6·583	2·429
	35	,, ,,	20·0	13·3				5·453	2·410
	36	,, ,,	19·6	13·3				5·601	2·393
	37	,, ,,	16·9	13·9				4·242	2·404
	38	,, ,,	18·0	10·0				3·722	2·428
	39	,, ,,	16·9	11·0				3·831	2·432
	40	,, ,,	17·5	10·4				3·470	2·401
	41	,, ,,	16·0	12·0				3·689	2·406
	42	,, ,,	15·0	10·8				2·580	2·400
	43	,, ,,	17·8	11·8				4·500	2·414
	44	,, ,,	31·9	25·0				27·020	2·391
	45	,, ,,	30·3	22·8				32·279	2·383
	46	,, ,,	28·5	20·0				20·383	2·409
	47	,, ,,	27·0	18·7				15·300	2·393
	145	,, ,, (broken)	25·0	20·2				(6·689+)	2·390
		Range	15·0 to 36·5	10·0 to 27·8				2·580 to 41·831	2·369 to 2·436
		Average	22·6	16·5	( ) not included in average			12·041 (43 specimens)	2·408
16 Ovals (10·8%)	48	Oval (broad)		17·9	39·3	31·9		28·808	2·403
	49	,, (broad)		18·5	35·6	28·2		22·604	2·402
	50	,,		15·1	30·5	22·2		12·155	2·396
	51	,,		13·5	28·8	24·0		10·849	2·396
	52	,,		12·9	28·6	20·1		9·474	2·428
	53	,,		13·0	27·8	22·9		9·365	2·380
	54	,, (broad)		11·7	26·3	20·4		7·792	2·391
	57	,,		10·3	23·9	17·9		5·727	2·428

TABLE 1 (*continued*)

	Collection Number	Shape Type	Diameter (mm)	Depth (mm)	Length (mm)	Width (mm)	Flange width (mm)	Weight (gms)	Sp. gr.
		Range		7·9 to 28·4	16·8 to 46·4	13·9 to 44·5		2·550 to 72·349	2·370 to 2·427
		Average		14·5	24·2	20·8		12·556	2·404
18 Boats (12·2%)	69	Boat		7·3	23·2	12·3		2·599	2·391
	70	,,		8·2	21·6	11·6		2·450	2·387
	71	,,		6·2	23·9	14·2		2·809	2·393
	72	,,		6·0	19·5	14·3		1·818	2·405
	73	,,		5·0	22·8	14·1		1·447	2·396
	74	,, (canoe-like in one aspect)		5·8	21·2	8·9		1·310	2·390
	75	,,		5·8	20·2	10·3		1·500	2·384
	76	,,		7·3	24·1	10·6		2·302	2·431
	77	,, (small)		5·2	15·1	10·5		0·772	2·393
	79	,,		9·9	31·6	12·9		5·268	2·397
	80	,,		7·5	30·2	12·1		3·662	2·394
	82	,,		7·6	29·1	13·2		3·689	2·396
	83	,,		8·9	26·7	15·0		4·416	2·393
	86	,,		8·5	22·0	14·9		3·124	2·409
	89	,,		9·7	22·8	15·5		4·183	2·381
	90	,,		13·8	39·2	19·0		12·236	2·404
	115	,,		7·1	23·0	16·0		2·300	2·385
	133	Boat		6·7	20·0	13·3		2·204	2·379
		Range		5·0 to 13·8	15·1 to 39·2	8·9 to 19·0	(2·3)[1]	0·772 to 12·236	2·379 to 2·431
		Average		7·0	23·1	13·3	(2·3)[1]	3·233	2·395
7 Boat cores (4·7%)	55	Boat core		12·3	33·9	19·9		9·557	2·406
	56	,, ,,		10·9	27·5	17·6		6·227	2·376
	58	,, ,,		11·0	29·7	18·1		7·168	2·411
	81	,, ,,		9·7	29·4	12·9		4·587	2·386
	85	,, ,,		10·1	22·0	14·2		3·415	2·379
	96	,, ,,		8·9	39·7	11·7		5·866	2·429
	146	,, ,, (broken)		15·7	(22·0; orig. 30-35)	17·7		(6·689)[2]	2·390

TABLE 1 (*continued*)

Collection Number	Shape Type	Diameter (mm)	Depth (mm)	Length (mm)	Width (mm)	Flange width (mm)	Weight (gms)	Sp. gr.
	Range		8·9 to 15·7	22·0 to 39·7	11·7 to 19·9		3·415 to 9·557	2·376 to 2·429
	Average		11·2	30·4	16·0		6·137	2·397
132	Canoe		7·8	22·8	11·4		2·040	2·437
60	Dumbbell		7·8-G 5·5-W	40·2	11·5-G 8·1-W		4·341	2·408
61	,,		8·8-G 5·8-W	36·9	12·0-G 7·6-W			
62	,,		6·0 and 6·2-G 2·5-W	40·0	10·4-G 6·0-W	1·5	4·312	2·418
63	,,		6·7 and 7·5-G 5·5-W	31·2	9·8 and 10·2-G 8·7-W		2·650	2·374
64	,,		6·2-G 4·6-W	32·9	9·8-G 8·1-W		2·945	2·407
65	,,		6·5-G 5·0-W	33·6	10·8-G 8·0-W		2·606	2·392
104	,,		8·3 and 9·3-G 7·7-W	30·5	12·0 and 12·5-G 11·1-W		2·818	2·404
105	,,		6·8-G 6·1-W	26·2	10·7-G 9·7-W		4·669	2·393
106	,,		5·1 and 5·2-G	24·4	9·0 and 9·2-G 7·5-W		2·463	2·422
107	,,		6·6-G 5·9-W	25·8	11·2-G 10·2-W		1·651	2·407
108	,,		5·0 and 5·2-G 4·6-W	21·0	8·2 and 8·9-G 7·6-W		2·471	2·389
							1·182	
	Range		5·0 to 9·3-G 2·5 to 7·7-W	21·0 to 40·2	8·2 to 12·5-G 6·0 to 11·1-W		1·182 to 4·341	2·370 to 2·422
	Average		6·8-G 5·3-W	31·2	10·6-G 8·5-W		2·901	2·399

11 Dumbbells (7·5%)

TABLE 1 (*continued*)

	Collection Number	Shape Type	Diameter (mm)	Depth (mm)	Length (mm)	Width (mm)	Flange width (mm)	Weight (gms)	Sp. gr.
4 Dumbbell cores (2·7%)	66	Dumbbell core		9·3 and 9·8-G 8·1-W	47·0	13·1-G 10·8-W		7·731	2·435
	67	,, ,,		12·8-G 11·4-W	49·0	15·2-G 14·0-W		13·644	2·388
	68	,, ,,		9·0 and 9·5-G 8·6-W	36·1	12·2-G 11·3-W		5·414	2·415
	78	,, ,,		7·9 and 9·4-G 7·2-W	42·8	13·4-13·9-G 12·0-W		7·012	2·390
		Range		7·9 to 12·8-G 7·2 to 11·4-W	36·1 to 49·0	12·2 to 15·2-G 10·8 to 14·0-W		5·414 to 13·644	2·388 to 2·435
		Average		10·0-G 8·8-W	43·7	13·5-G 12·0-W		8·450	2·407
5 Peanut-like Dumbbells (3·4%)	91	'Pea-nut'-like dumbbell (rounded ends)		11·2	38·8	12·6		8·223	2·397
	92	,, ,, (rounded ends)		11·3	39·7	12·2		7·721	2·434
	93	,, ,, (rounded ends)		10·5	34·3	11·2		6·316	2·421
	94	,, ,,		10·3	31·1	11·9		4·857	2·376
	103*	,, ,, (pointed ends)		8·1 to 8·5*	28·5	9·7 to 10·6*		3·147	2·374
		Range		8·1 to 11·3	28·5 to 39·7	9·7 to 12·6		3·147 to 8·223	2·374 to 2·434
		Average		10·3	34·5	11·8		6·053	2·400

TABLE 1 (*continued*)

	Collection Number	Shape Type	Diameter (mm)	Depth (mm)	Length (mm)	Width (mm)	Flange width (mm)	Weight (gms)	Sp. gr.
16 Ovals (10·8%)	59	,,		11·2	25·2	18·2		5·723	2·412
	87	,,		13·5	22·7	17·2		5·324	2·382
	88	,,		11·7	21·5	15·7		4·365	2·427
	118	,, (small)		4·0	13·2	11·2		0·733	2·427
	120	,, (small, plus bubble crater)		3·2	9·3	8·6		0·314	2·429
	121	Oval (small)		6·0	12·4	11·7		0·975	2·397
	122	,, (small 'pip-like')		5·6	11·1	8·2		0·521	2·393
	131	Oval		9·5	16·8	14·0		2·171	2·401
		Range		3·2 to 18·5	9·3 to 39·3	8·2 to 31·9		0·314 to 28·808	2·380 to 2·429
		Average		11·7	23·3	18·3		7·931	2·406
17 Oval cores (11·5%)	1	Oval core		28·4	46·4	44·5		72·349	2·380
	3	,, ,,		23·8	37·5	35·0		39·691	2·393
	7	,, ,,		21·8	33·0	31·0		27·077	2·400
	34	,, ,,		11·9	20·7	18·8		5·823	2·407
	84	,, ,,		10·9	24·3	20·4		5·868	2·408
	124	,, ,, (conical)		10·8	18·7	17·1		4·793	2·425
	125	,, ,, (conical)		10·6	19·2	15·8		3·363	2·397
	126	,, ,,		10·8	18·7	17·1		4·793	2·425
	128	,, ,,		11·2	16·8	15·5		3·173	2·421
	129	,, ,, (conical)		9·3	21·4	16·9		3·670	2·402
	130			7·9	19·6	13·9		2·550	2·388
	139	,, ,,		15·2	21·5	18·5		7·662	2·417
	140	,, ,,		12·9	26·5	20·5		8·232	2·427
	141	,, ,,		17·9	24·3	20·0		8·284	2·389
	142	Oval core (conical)		16·2	22·2	15·2		5·853	2·397
	143	,, ,,		14·7	22·5	16·0		5·705	2·370
	144	,, ,,		12·5	18·9	16·8		4·574	2·417

TABLE 1 (*continued*)

	Collection Number	Shape Type	Diameter (mm)	Depth (mm)	Length (mm)	Width (mm)	Flange width (mm)	Weight (gms)	Sp. gr.
Oval 'nut-like' form (0·7%)	95	Oval 'nut-like' form		12·2	22·0	13·4		4·809	2·411
16 Teardrops (10·8%)	97	Teardrop		9·2	24·5	13·2		2·945	2·407
	98	,,		11·3	22·8	15·4		3·681	2·348
	99	,,		10·2	20·8	15·1		3·255	2·393
	100	,,		11·0	23·4	13·5		2·894	2·358
	101	,,		9·3	21·5	13·3	2 (worn)	2·546	2·388
	102	,,		7·8	16·4	11·3		1·464	2·414
	109†	,,		10·2	37·3	13·4		5·740	2·408†
	110†	Teardrop tail		7·0	28·0	6·7		1·219	2·403†
	113	Teardrop		16·2	32·0	16·4		8·886	2·423
	114	,,		13·6	28·8	15·5		6·132	2·407
	123	,, (small)		6·0	15·0	10·0		0·821	2·409
	127	,,		12·4	21·2	13·6		4·132	2·406
	134	,, (slender)		5·5	19·8	9·3		1·324	2·398
	135	,, (small)		7·5	15·1	10·8		1·134	2·358
	136	,, (small)		6·1	15·2	10·7		1·030	2·413
	137	,,		7·6	18·2	12·3	1·8 (worn)	1·471	2·393
		Range		5·5 to 16·2	15·0 to 37·3	6·7 to 16·4		0·821 to 8·886	2·348 to 2·423
		Average		10·0	22·5	12·5		3·042	2·395
2 Teardrop cores (1·3%)	147	Teardrop core		19·0	23·2	20·5		8·651	2·411
	148	,, ,,		15·0	16·3	16·8		4·636	2·371
		Range		15·0 to 19·0	16·3 to 23·2	16·8 to 20·5		4·636 to 8·651	2·371 to 2·411
		Average		17·0	19·8	18·7		6·644	2·391
	TOTALS	Range	12·6 to 36·5	2·5 to 28·4	9·3 to 49·0	6·7 to 44·5	1·5 to 2·6	0·314 to 72·349	2·348 to 2·437
		Average	22·0	12·1	25·3	15·2		7·817	2·405

[1] ( ) one value only.
( ) not included in average
G = gibbosity.
W = waist region.
Where two values are given for G, this means unequal gibbosities.
* The only one with marked differences in size of the two gibbosities.
† Combined for purposes of calculating averages.
(Weights and specific gravities determined by T. H. Donnelly, Nov., 1964.)

TABLE 2

Showing average values and range in values of dimensions, weights and specific gravities of 148 australites from Morgan, S.A.

Shape Type	No. of Specimens	Percent of Population		Diameter (mm)		Depth (mm)		Length (mm)		Width (mm)		Flange Width (mm)		Weight (gms)		Specific Gravity
Flanged buttons	3	2·0	R	12·6 to 20·2	R	6·0 to 9·0	R		R		R		R	1·027 to 3·349	R	2·389 to 2·410
			A	15·9	A	7·2	A		A		A	(2·6)	A	1·988	A	2·401
Hollow button (broken)	1	0·7	R		R		R		R		R		R		R	
			A	22·5	A	10·6 (broken)	A		A		A		A	4·045	A	2·411
Lenses	2	1·3	R	16·4 to 16·9	R	7·4 to 8·2	R		R		R		R	2·212 to 2·275	R	2·392 to 2·400
			A	16·7	A	7·8	A		A		A		A	2·234	A	2·396
Round cores	44	29·7	R	15·0 to 36·5	R	10·0 to 27·8	R		R		R		R	2·580 to 41·831	R	2·369 to 2·436
			A	22·6	A	16·5	A		A		A		A	12·041 (43 spp.)	A	2·408
Ovals	16	10·8	R		R	3·2 to 18·5	R	9·3 to 39·3	R	8·2 to 31·9	R		R	0·314 to 28·808	R	2·380 to 2·429
			A		A	11·7	A	23·3	A	18·3	A		A	7·931	A	2·406
Oval cores	17	11·5	R		R	7·9 to 28·4	R	16·8 to 46·4	R	13·9 to 44·5	R		R	2·550 to 72·349	R	2·370 to 2·427
			A		A	14·5	A	24·2	A	20·8	A		A	12·556	A	2·404

TABLE 2—*continued*

Shape Type	No. of Speci-mens	Percent of Popula-tion		Diameter (mm)		Depth (mm)		Length (mm)		Width (mm)		Flange Width (mm)		Weight (gms)		Specific Gravity
Boats	18	12·2	R		R	5·0 to 13·8	R	15·1 to 39·2	R	8·9 to 19·0	R		R	0·772 to 12·236	R	2·379 to 2·431
			A		A	7·0	A	23·1	A	13·3	A	(2·3)	A	3·233	A	2·395
Boat cores	7	4·7	R		R	8·9 to 15·7	R	22·0 to 39·7	R	11·7 to 19·9	R		R	3·415 to 9·557	R	2·376 to 2·429
			A		A	11·2	A	30·4	A	16·0	A		A	6·137	A	2·397
Canoe	1	0·7	R		R		R		R		R		R		R	
			A		A	(7·8)	A	(22·8)	A	11·4	A		A	2·040	A	2·437
Dumbbells	11	7·5	R		R	5·0 to 9·3 (gibbosity) 2·5 to 7·7 (waist)	R	21·0 to 40·2	R	8·2 to 12·5 (gibbosity) 6·0 to 11·1 (waist)	R		R	1·182 to 4·341	R	2·370 to 2·422
			A		A	6·8 (gibbosity) 5·3 (waist)	A	31·2	A	10·6 (gibbosity) 8·5 (waist)	A	(1·5)	A	2·901	A	2·399
Dumbbell cores	4	2·7	R		R	7·9 to 12·8 (gibbosity) 7·2 to 11·4 (waist)	R	36·1 to 49	R	12·2 to 15·2 (gibbosity) 10·8 to 14·0 (waist)	R		R	5·414 to 13·644	R	2·388 to 2·435
			A		A	10·0 (gibbosity) 8·8 (waist)	A	43·7	A	13·5 (gibbosity) 12·0 (waist)	A		A	8·450	A	2·407

TABLE 2—*continued*

Shape Type	No. of Speci-mens	Percent of Popula-tion		Diameter (mm)		Depth (mm)		Length (mm)		Width (mm)		Flange Width (mm)		Weight (gms)		Specific Gravity
"Pea-nut"-like dumb-bells	5	3·4	R		R	8·1 to 11·3	R	28·5 to 39·7	R	9·7 to 12·6	R		R	3·147 to 8·223	R	2·374 to 2·434
			A		A	10·3	A	34·5	A	11·8	A		A	6·053	A	2·400
Oval "nut-like" form	1	0·7	R		R		R		R		R		R		R	
			A		A	12·2	A	22 0	A	13·4	A		A	4·809	A	2·411
Teardrops	16	10·8	R		R	5·5 to 16·2	R	15·0 to 37·3	R	6·7 to 16·4	R		R	0·821 to 8·886	R	2·348 to 2·423
			A		A	10·0	A	22·5	A	12·5	A	(1·8 worn)	A	3·042	A	2·395
Teardrop cores	2	1·3	R		R	15·0 to 19·0	R	16·3 to 23·2	R	16·8	R	to 20·5	R	4·636 to 8·651	R	2·371 to 2·411
			A		A	17·0	A	19·8	A	18·7	A		A	6·644	A	2·391
TOTALS	148	100	R	12·6 to 36·5	R	2·5 to 28·4	R	9·3 to 49·0	R	6·7 to 44·5	R	1·5 to 2·6	R	0·314 to 72·349	R	2·348 to 2·437
			A	22·0	A	12·1	A	25·1	A	15·2	A	2·1	A	7·817	A	2·405

R = Range in values. A = Arithmetic mean. Round forms = 50%, elongated forms = 50%.

are statistically significant, comparison between the percentages of shape types represented in each area shows certain marked differences (Table 3). 'Classifiable' means specimens other than nondescript fragments and fragments for which the original shape type is rather uncertain.

TABLE 3

Comparison of percentages of different shape types of australites from (a) near Morgan, (b) Florieton, and (c) Mulka, S.A.

	Shape type	Percentage of shape types		
		(a) 16 miles NNE. of Morgan (%)	(b) Florieton* (%)	(c) Mulka† (%)
Round forms	Flanged buttons and/or buttons with flange remnants	2·0	0·4	10·0
	Hollow forms (broken and unbroken)	0·7	0·0	1·9
	Button cores, lenses and larger round scores	31·0	64·9	27·8
	Spherical forms		0·7	
Elongated forms	Ovals and oval cores	23·0	9·0	21·1
	Boats and boat cores	16·9	12·4	23·0
	Canoes	0·7	2·1	1·1
	Dumbbells and dumbbell cores	13·6	3·1	10·3
	Teardrops and pear-shaped forms	12·1	6·2	4·8
	Club-shaped forms		0·1	
	Cylindrical forms		1·1	
	TOTAL	100·0	100·0	100·0
	Number of specimens	148	812‡	261§

* Generalized from Mawson's (1958) list of shape types.
† Generalized from Baker's (in press) list of shape types.
‡ Total number collected was 1475 specimens, but 663 of these are only fragments of australites and not classifiable into specific shape groups.
§ Total number investigated in detail was 275 specimens, but 14 of these are fragments of australites (a total of 689 specimens were inspected in five different collections of australites from Mulka (Baker, in press)).

As for other concentration centres in the vast australite strewnfield, there is no apparent reason why the Morgan and Florieton areas, which are only some twenty miles apart, show such significantly different proportions of the more common of the shape types which constitute the bulk of the australite populations. Taken over the two million square mile strewnfield as a whole, round forms tend to be 1½ to 3 times as abundant as elongated forms, as shown in Table 4.

TABLE 4

Ratios of round to elongated forms of australites from various concentration centres in the Australian strewnfield

Concentration centre (or region)	Ratios of the main australite shape types (Round/elongated)
Nirranda, Victoria	3/1
Charlotte Waters, Central Australia	2·49/1 [a]
Port Campbell, Victoria	2·4/1
Florieton, South Australia	1·94/1
Nullarbor Plain, S.A.-W.A.	1·83/1 [a]
Moonlight Head, Victoria	1·83/1 [a]
Kanagulk-Telangatuk East-Toolondo, Victoria	1·81/1 [c]
Harrow, Victoria	1·43/1 [d]
Nurrabiel, Victoria	1·33/1 [b]
Mulka, South Australia	0·51/1
Morgan, South Australia	0·5/1

[a] Calculated from Baker's tables (1956).
[b] From Baker (1964).
[c] From Baker (1959b).
[d] From Baker (1955).

Apart from variations in the percentages of the various shape types from Morgan to Florieton, and from these areas to Mulka, as shown in Table 3, there are also considerable variations between the overall percentages of round forms to elongated forms as shown in Table 5.

TABLE 5

Variations in populations, specific gravity values, and weights of australites from (a) near Morgan, (b) Florieton, and (c) Mulka, S.A.

	(a) Morgan		(b) Florieton		(c) Mulka*	
	Round forms	Elongated forms	Round forms	Elongated forms	Round forms	Elongated forms
Number of specimens	50	98	536	276	107	168
Percentage of total number	34%	66%	66%	34%	39%	61%
Average weight in grams	10·90	6·19	3·87	3·62	3·53	4·50
Average specific gravity	2·407	2·400	(–)	(–)	2·434	2·427

(–) no specific gravity determinations listed in Mawson's (1958) paper.
* from Baker (in press)—the obviously hollow specimens have been excluded from the calculations of specific gravity.

There are also marked differences in the weight ranges and average weight values as between the various shape groups represented in each of the Morgan and Florieton areas (Table 6).

TABLE 6

Comparison of weight ranges and average weight values of different shape groups of australites from near Morgan and from Florieton, S.A.

	Shape type	Morgan, S.A.		Florieton, S.A.	
		Range in weight (gms)	Average weight (gms)	Range in weight (gms)	Average weight (gms)
Round forms	Flanged buttons	1·03 to 3·35	1·29	1·94 to 3·01	2·51
	Hollow button (broken)		4·05		
	Lenses	2·12 to 2·28	2·23	0·18 to 5·92	1·40
	Round cores	2·58 to 41·83	12·04	1·01 to 12·02	5·31
	Spherical forms			8·91 to 9·90	8·84
Elongated forms	Ovals	0·31 to 28·81	7·93	0·60 to 21·26	6·93
	Oval cores	2·55 to 72·56	12·46	1·11 to 15·00	4·83
	Boats	0·77 to 12·24	3·23	0·27 to 15·35	2·86
	Boat cores	3·42 to 9·56	6·14		
	Canoes		2·04	0·50 to 6·69	2·73
	Dumbbells	1·18 to 4·34	2·90	0·76 to 4·05	2·61
	Dumbbell cores	5·41 to 13·64	8·45		
	"Peanut-like" forms	3·15 to 8·22	6·05		
	Teardrops & pear-shaped forms	0·82 to 8·89	3·04	0·30 to 8·40	2·07
	Teardrop cores	4·64 to 8·65	6·64		
	Club-shaped forms				7·80
	Cylindrical forms			2·39 to 14·78	6·72
Overall weight range		0·314 to 72·349		0·18 to 21·26	
Overall average weight			7·817		3·784
Total weight		1,156·855		3,073	

Table 6 reveals that round cores, ovals, oval cores, dumbbell- and teardrop-shaped groups each have a greater weight range and significantly higher average weight from the area 16 miles NNE. of Morgan than from Florieton. Flanged buttons have a higher average weight from Florieton than from near Morgan, but numbers in this shape group are low at each locality and not statistically significant. Lenses have a higher average weight from near Morgan, although heavier-weight and lighter-weight individual specimens of lenticular side aspect occur at Florieton. However, numbers are not statistically significant for lenses from near Morgan, whereas they are for lenses from Florieton. Forms that are boat-shaped in plan aspect have a greater weight range from the Florieton area, but a greater average weight from 16 miles NNE. of Morgan, and there are statistically significant numbers of specimens in this shape group for both areas.

Overall, the australites are heavier from near Morgan than from Florieton in virtually all of the different shape groupings, and the degree of weathering is not significantly different for the specimens from these two close concentration centres. The Florieton specimens (812 classifiable into specific shape types among a total of 1475 finds) have a total weight of approximately 3073 gms as calculated from Mawson's table (1958, p. 163) showing the weights of specimens in the separate shape groups. This is 2·66 times greater than the total weight (1157 gms) of

specimens constituting the Thamm collection from Morgan, and the weight range of 0·18 gms to 21·26 gms is significantly lower than from Morgan, while the average weight of 3·784 gms is 2·06 times lower than for the Morgan specimens. With a weight range of 0·46 gms to 22·7 gms and an average weight of 4·1 gms, the Mulka specimens fall between those from near Morgan and from Florieton respectively. The 275 specimens described from Mulka have a total weight of 1136 gms (Baker, in press), but this figure is reduced to 1091 gms when the weight of the 14 fragments present is deducted.

Specific gravity values were not given for the Florieton specimens described by Mawson (1958), hence no average specific gravity can be cited for comparison with the average specific gravity of 2·405 for the australites from near Morgan. The average specific gravity (2·405) for the 148 specimens from Morgan is significantly lower than that (2·430) from Mulka, 390 miles away WNW. of Morgan (Baker, in press).

Sculpture patterns and structures of australites near Morgan, S.A.

Like most australites recovered from the semi-arid to arid regions, the sculpture patterns of the australites from 16 miles NNE. of Morgan are dominated by the effects of terrestrial weathering. All specimens are relatively strongly abraded, occasionally some are fractured, while some are pitted and etched on all surfaces including fracture surfaces. Abrasion has resulted largely from physical erosion by wind-borne, dried sandy soils. Pitting and etching have resulted largely from chemical erosion by soil etchants during wetter periods of the geologically recent past and the rather infrequent rainy seasons of the present. In general, the etching is an earlier event in the process of terrestrial erosion and occurs in soils. Abrasion is mainly a later development after release of the tektites by soil deflation. Specimens swept or gravitated into recent sedimentary horizons (e.g. as in clay pans) may be subjected to further solution etching after various degrees of abrasion have occurred.

The worn character of all of the specimens is such that although most shape types are still recognizable, there is generally little or nothing preserved of the aerodynamical sculpture pattern. Few flow ridges of the ring wave pattern that was produced during the later stages of high velocity flight are still evident, and these are invariably rather indistinct, worn-down stumps of the original flow ridges (see Table 7 for specimens with some remnants of the ring wave pattern).

Very few specimens still retain the circumferential flange structure (Pl. 9, fig. 1) or remnants thereof (Pl. 11, fig. 19), and many have been so exfoliated on their front surfaces and/or around their perimeters that the sub-surface, strained, aerodynamically heated zone of the anterior surface region (Baker, 1963) has been spalled away to different degrees, sometimes completely or nearly so where the remnant conical core types of specimens are concerned (e.g. Pl. 10, fig. 26), and where flaked equatorial zones are prominently present around the peripheries of the specimens (e.g. Pl. 11, fig. 6). Flow swirls are occasionally evident on the posterior surface of some of these australites (Table 7) and when present are only poorly preserved or very indistinct (Pl. 9, fig. 45; Pl. 10, fig. 1-3).

One effect of the relatively advanced degree of terrestrial erosion is that the weights of the specimens as recorded in Table 1 are inevitably much lower values than the landing weights and the average weights given in Table 2 are thus minimal values. Specimens with sizable internal bubble cavities have had the outer walls of parts of the bubbles penetrated and removed by erosion, leaving relatively deep crater-like depressions with dulled and eroded walls (e.g. Pl. 9, fig. 3; Pl. 10, fig. 6,

TABLE 7

Surface Features of 148 australites from Morgan, S.A.

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
1	Oval core	II, 2	10·8		1-5·4 mm across 3·1 mm deep on posterior surface	one—22·1 mm × 26·2 mm	Sub-vitreous lustre from natural solution etch polishing
2	Round core	III, 1	10·9			Indistinct on posterior surface	Smoothed and dulled by abrasion
3	Oval core	II, 1	12·4				Smoothed and dulled by abrasion
4	Round core	III, 2	11				Etch pits and vague flow lines on all surfaces, best on posterior surface
5	,, ,,	III, 3	10·5		4·2 × 3·3 mm on anterior surface—0·6 mm deep	Fold-like flow lines on posterior surface	? small gas blister on posterior surface
6	,, ,,	III, 5	9·9				Vitreous recent fracture surface at one side of posterior surface
7	Oval core	II, 3	8			One—17 × 22 mm on posterior surface	Old, lightly etched fracture from anterior surface
8	Round core	I, 38	11·4				Flow lines reasonably well revealed
9	,, ,,	I, 43	10·9				Etch pits and 'orange-peel' effect
10	,, ,,	I, 42	8·8				Fold-like flow line pattern and some etch pits

Plates I-IV in Table 7 = Plates 9-12 elsewhere.

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
11	Round core	I, 41	8·3				Anterior surface smoothed by abrasion; posterior surface with central etch pit pattern
12	,, ,,	I, 39	9·8				Part of former rim preserved, mostly = flaked equatorial zone
13	,, ,,	I, 36	8·2				Flaked equatorial zone unequally developed; few pits, some flow lines
14	,, ,,	I, 37	8·2				Fold-like flow lines, some etch pits, side aspect approaching conical (1-13 above, the side aspect = bung-like)
15	,, ,,	I, 26	9·9				Abraded smooth on most surfaces
16	,, ,,	I, 35	9·8				Some etch pits; parts abraded smooth; side aspect approaching conical
17	,, ,,	I, 40	8·7				Fold-like flow lines; some etch pits
18	,, ,,	I, 22	11·7				Old, dulled conchoidal fracture to one edge of posterior surface
19	,, ,,	I, 27	9·2				Smoothed; plus some etch pits
20	,, ,,	I, 31	8·6				Smoothed; plus some etch pits and a few flow lines
21	,, ,,	I, 29	8·4		one; = 0·34 mm diameter; 0·17 mm deep		Small etch pits; several bubble pits 0·5 to 2·5 mm diameter on both surfaces are up to 0·02 mm deep

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
22	Round core	I, 25	9·5				Etched 'collisional bruise' pits on both surfaces
23	„ „	I, 23	8·5			16 mm across on posterior surface (worn)	Round core slightly fractured on one side. Smoothed posterior surface
24	„ „	I, 32	7·8				Flow lines and some etch pits
25	„ „	I, 30	7·5				Etch pits and grooves; plus a few flow lines
26	„ „	I, 33	7·2				Abraded, few pits; conchoidal fracture surface at one edge of posterior surface
27	„ „	I, 34	6·0				Abraded, few pits and flow lines
28	„ „	I, 18	7·3				Abraded, few pits
29	„ „	I, 28	8·7			Indistinct on posterior surface	Conical core; worn; flow lines and etch pits
30	„ „	I, 24	12·8				Worn; fine etch pits and few flow lines
31	„ „	I, 16	6·4		one = 0·37 mm on f.e.z.* (unusual feature) 0·2 mm deep		Abraded; few flow lines and etch pits. Ant. surf.† approaching flatness
32	„ „	I, 19	11·2				Abraded conical core with flaked equatorial zone indistinct. Etch pits and flow lines
33	„ „	I, 15	11·0				Posterior surface almost flat (from erosion?)
34	Oval core	II, 21	6·9				Some etched flow lines and pits
35	Round core	I, 21	7·9				Complex, fold-like pattern of flow lines on posterior surface; etched

* f.e.z. = flaked equatorial zone. † Ant. surf. = anterior surface.

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
36	Round core	I, 20	6·8				Complex, fold-like pattern of flow lines on posterior surface and some on anterior surface; etched
37	,, ,,	I, 11	8·6				Abraded to a degree after previous natural solution etching
38	,, ,,	I, 17	5·6				Smoothed by abrasion, few small etch pits
39	,, ,,	I, 12	7·0				A few bubble pits and etch pits, lesser flow lines
40	,, ,,	I, 9	5·2				Smoothed by abrasion, posterior surface with some deeply etched flow lines
41	,, ,,	I, 10	5·8				Smoothed by abrasion, posterior surface with pits and a few flow lines
42	,, ,,	I, 13	6·7				Abraded conical core; pits and few etched flow lines on posterior surface
43	,, ,,	I, 14					Conical core abraded; fine etch pitting, few flow lines, ? 'collisional bruises'
44	,, ,,	I, 46	12·7				Smoothed by abrasion; fine etch pits, few flow lines
45	,, ,,	III, 4	10·4				Fold-like pattern of flow lines on posterior surface; etch pits of varying size and pattern
46	,, ,,	I, 45	9·5			22·3 mm across on posterior surface	Also other flow lines in fold-like patterns on posterior surface; flow lines on anterior surface; etch pits on both

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
47	Round core	I, 44	9·0				Flaked equatorial zone indistinct towards anterior surface. Collisional bruise marks; few flow lines; abraded after natural etching
48	Broad oval	II, 4	7·9			One = 20·3 × 15·7 mm on posterior surface	Flow lines, etch pits and etch grooves
49	,, ,,	II, 5	9·0				Complex fold-like pattern of flow lines, etch pits and etch grooves common
50	Oval	II, 7	7·8				Some flow lines, etch pits and etch grooves
51	,,	II, 6	7·8				Abraded after etch pitting and etch grooving naturally. Small conchoidal fracture (old) at one end
52	,,	II, 8	7·3			One = 15·3 × 15·9 mm on posterior surface	Other flow lines and etch pits on all surfaces
53	,,	II, 11	7·0				Fracture fragment removed from one side; complex flow lines and pits
54	Broad oval	II, 12	6·5				Flaked equatorial zone indistinct. Smoothed by abrasion. A few flow lines, etch pits and exposed internal bubbles
55	Boat core	III, 9	6·2			One = 13·0 × 6·6 mm on posterior surface	Flaked equatorial zone indistinct. Smoothed by abrasion and etching. Fine flow lines and etch pits
56	,, ,,	III, 13	5·7				Flaked equatorial zone indistinct. Few flow lines, several etch pits; generally smoothed by abrasion

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
57	Oval	II, 15	5·7				Finely etch-pitted on all surfaces. Very few flow lines in evidence
58	Boat core	III, 10	5·3			One = 7·2 × 3·6 mm on posterior surface	Flaked equatorial zone indistinct on one side. Complex fold-like flow lines on posterior surface. Etch pits and areas smoothed by abrasion
59	Oval	II, 14	7·9				Complex fold-like pattern of fine flow lines and few etch pits. One exposed internal bubble = 0·14 mm across, 0·03 mm deep
60	Dumbbell	IV, 4	Rim present	worn away			Smoothed by abrasion. Fine etch pits; longitudinal flow lines on anterior surface
61	,,	IV, 6	,, ,,	,, ,,	5·5 across 0·9 deep on posterior surface 3·9 across 0·9 deep on anterior surface		A few flow lines and etch pits
62	,,	IV, 5	Flange remnants 1·5 mm wide	Faint remnants on waist			Etch polish and longitudinal flow lines; few etch pits
63	,,	IV, 11	Minute flange remnants	Vaguely concentric remnants			Smoothed by abrasion; few remnants of former etch pits and flow lines
64	,,	IV, 8	Rim present	worn away			One end conchoidally chipped. Longitudinal flow lines

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
65	Dumbbell	IV, 9	Rim present	worn remnants on waist			Longitudinal flow lines on posterior surface and some on anterior surface. Some etch pits
66	Dumbbell core	IV, 3	6·8 on gibbosities				Smoothed by abrasion; few etch pits and flow lines
67	,, ,,	IV, 1	8·0 on gibbosities				Smoothed by abrasion; few etch pits and flow lines; occasional lunate collisional bruise-marks
68	,, ,,	IV, 7	6·5				Smoothed by abrasion; finely etch-pitted; few flow lines on anterior surface
69	Boat	III, 18	Minute remnants of flange base	worn concentric			Longitudinal, somewhat contorted flow lines; two exposed internal bubbles on anterior surface 0·23 mm across and 0·17 mm across
70	,,	III, 29	rim present	worn away			Finely etch-pitted with few flow lines
71	,,	III, 22					Finely etch-pitted; few flow lines. Posterior surface flat (slightly concave to the feel but scarcely visible)
72	,,	III, 25	Minute flange remnant on one side	worn, vague, ? concentric			Etch-pitted and etch-grooved; few flow lines
73	,,	III, 27	Rim present	worn, vague ridges			Abraded; remnants of longitudinal flow lines, few etch pits. Small conchoidal chip from one edge near exposed small internal bubble 0·17 mm across

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
74	Boat (Canoe-like appearance in one aspect)	III, 28	,, ,,				Ends taper; longitudinal flow lines
75	Boat	III, 30	,, ,,				Etch pits and longitudinal flow lines. Facets at one end due to chipping (followed by etch-pitting)
76	,,	III, 26	,, ,,				Smoothed by abrasion. Originally could have been a canoe, but too worn for certainty
77	,,	III, 31	minute, thin flange remnants	clockwise spiral; worn			Contorted flow-lines on posterior surface; a few etch pits are very minute
78	Dumbbell core	IV, 2	4·8 on one gibbosity				Visually dumbbell-shaped in side aspect only. Complex flow-line pattern on posterior surface, few pits
79	Boat	III, 11					Finely etch-pitted and partially smoothed by abrasion
80	,,	III, 16		worn away			Complex, fold-like flow pattern on posterior surface with long axes parallel to long axis of form. Also on anterior surface. Etch pits and grooves on both surfaces

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
81	Boat core	III, 15	6·9				Abraded; smooth flaked equatorial zone and anterior surface. Remnant etch pit pattern on posterior surface. Conical in end-on aspect
82	„ „	III, 14	Minute remnants of flange along sides	Vague remnants concentric			Few flow lines and etch pits on both surfaces. Anterior surface mainly smooth
83	Boat	III, 17	Rim present, flange stumps showing in spots	Vague remnants wavy from interference in equatorial regions			Flow lines and few etch pits on both surfaces
84	Oval core	II, 13	7				Flow lines and few etch pits on both surfaces
85	Boat core	III, 23	7·1				Conical in end-on aspect. Smoothed by abrasion; few etch pits
86	Boat	III, 20	Rare stumps of former flange left	Clockwise ridges perceptible			Posterior surface pitted with few flow lines. Anterior surface smoother with much finer etch pits
87	Oval	II, 17	Remnants of flange stumps around edges	7 closely spaced, concentric, worn		$0{\cdot}2 \times 0{\cdot}1$ mm to $7{\cdot}5 \times 6{\cdot}3$ mm on posterior surface	Smooth, plus fine flow lines, very rare pits; several 'saw-cuts' = etch grooves 0·3 mm wide. Concave etched fracture surface at one end
88	„	II, 18	„ „	Indistinct remnants	Two as figure 8 5 mm × 3·2 mm, 1·2 mm deep		Complex fold-like pattern of flow lines on both surfaces

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
89	Boat	III, 21					Smoothed by abrasion, finely pitted (worn down etch pits and abrasion pits)
90	,,	III, 7	Rim present, rounded by wear				Very complex flow-line pattern on both surfaces; few etch pits and grooves
91	'Peanut' type (rounded ends)	IV, 18			One = 3·7 × 1·7 mm other = 3·7 × 2·7		Waist-like region = 10·4 × 10·8 mm thick. Surface with some pits and 'collisional bruise-marks'
92	,,	IV, 17	5·3 (very worn)				Thinner end = 10·9 × 10·2 mm. Few flow lines tend to be longitudinal. Several pits = ? exposed internal bubbles (no slight constriction in waist)
93	,,	IV, 19	4·0 (indistinct)				Abraded smooth with remnants of pits showing. No perceptible constriction of 'waist'
94	'Peanut' type (pointed ends)	IV, 20		Worn longitudinal ridges converge to pointed ends			Longitudinal to fold-like flow lines, few pits and 'collisional bruise-marks'
95	Oval 'Nut-like' form	IV, 21					Fold-like flow lines and occasional etch pits and short grooves
96	Boat core	III, 8	5·6 (indistinct)				Smoothed by abrasion; few poorly marked flow lines showing, but several pits (etch pits and ? exposed internal bubbles)

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
97	Teardrop	IV, 28	4·1 to 1·3 mm deep				Longitudinal flow lines constricting into tapered end. Tail of tear broken off and end worn
98	,,	IV, 27	Rim present 5·0 on gibbosity‡				Pit 0·15 mm across and 0·2 mm deep on anterior surface. Smoothed by abrasion, few pits and flow lines, rare small grooves evident
99	,, (lustrous from etching)	IV, 29	Rim present	Vague remnants of concentric ridges		8·2 × 6·2 mm on posterior surface	Flow lines in tail crowd into the attenuation. Radial star-like (12 rays) pattern of etch grooves in centre of posterior surface of gibbosity
100	,,	IV, 30	4·7 on gibbosity‡		6·1 mm across on posterior surface and 4·9 mm deep		Smoothed by abrasion; flow lines occasionally worn, trend into the attenuation. Few pits from earlier etching process
101	,,	IV, 31	Flange remnant 2 mm wide at end of gibbosity	Fairly clear concentric, wrinkled on gibbosity			Parts of flow ridges tend to show spiral clockwise trend. Partly smoothed by abrasion; few etch grooves and pits
102	,,	IV, 35	Rim present				Smoothed by abrasion; few flow lines and occasional pits (etch pits and exposed small bubbles)

‡ F.e.z. at broad end of gibbosity → surface worn and may be original structural feature rather than a f.e.z. caused by later weathering on earth's surface. (F.e.z. = flaked equatorial zone.)

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery; depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
103	Dumbbell (approach-'Peanut' type with pointed ends)	IV, 12	,, ,,	Very vague remnants	Etched-out crater = 6·1 × 4·5 mm, and 0·1 mm deep		Smoothed by abrasion; few flow lines trend to pointed ends. Few pits; some flow lines overdeepened and groove-like
104	Dumbbell (slightly distorted)	IV, 10			4·4 mm × 3·8 mm, and 0·07 mm deep on anterior surface		Complex pattern of fold-like flow lines on both surfaces, also a few pits (etch pits and exposed small bubbles)
105	Dumbbell	IV, 13	Worn rim present	Vague concentric			Anterior surface evenly curved without waist depression occurring; smoothed by abrasion. Flow lines not distinguishable. Fine etch pits and few bubble pits.
106	,,	IV, 15	,,				Smoothed by abrasion; waist depression scarcely perceptible on anterior surface. Fine etch pits and few flow lines
107	,,	IV, 14	Worn rim present and small stump of flange				Smoothed by abrasion; remnant etch pits and rare flow lines showing. Waist depression imperceptible on anterior surface
108	,,	IV, 16	Worn rim present				Complex pattern of twisted flow lines trending generally length-wise. No waist depression evident on anterior surface

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery, depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
109	Long teardrop	IV, 26	2·7 to 4·6 deep	Worn away			Tail (probably similar to No. 110) broken off. Attenuated end slightly recurved—smoothed by abrasion; a few longitudinal flow lines; few pits
110	Long tail of large teardrop		Rim relatively sharp				Longitudinal tapering flow lines well-defined; few etch pits. Fractured end as etched as other surfaces
111	Flanged button (1/11 of flange missing)	I, 1 and 2		Worn, but discernible as anti-clockwise spiral	Worn exposed internal pit on anterior surface		Radial flow lines on anterior surface. Etch pits and, across diameter, flow lines on posterior surface of core. Dull etch varnish; etch pits on flanges
112	Worn, broken, hollow button	I, 3 and 4	Worn stumps of flange band left	Worn, but irregularly anticlockwise spiral	Worn opening of cavity 13·8 mm across	Remnants of swirl 16 mm across on posterior surface	Cavity approximately 15 mm diameter, worn through on posterior surface thinner wall. Cavity wall flow lined and etch-pitted; Radial to complex flow lines on anterior surface
113	Teardrop	IV, 22	3 small facets in end-on view of gibbosity = probably fracture facets				Approximately circular in end-on aspect—smoothed by abrasion; few etch pits, twisted flow lines not plainly shown. Tail end fractured and rounded
114	,,	IV, 23					Tail end fractured and worn. Sculpture pattern = mainly etch pits and bubble pits up to 2·0 mm across

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery, depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
115	Boat with flange remnants	III, 19	Flange (thin, broken)	Few, worn, concentric		8·0 × 5·2 mm on posterior surface	Complex fold-like flow line pattern on both surfaces; few etch pits
116	Lens (probably originally a button)	I, 5	Rim present (worn)	Anticlockwise spiral (worn)			Across diameter, flow lines on posterior surface and on anterior surface; few etch pits
117	Button with 2 minute remnants of flange stump	I, 7		Concentric (worn)			Flow lines and occasional etch pits on both surfaces
118	Small oval with irregular outline from erosion	II, 32					Form relatively flat, with few flow lines and fine etch pits
119	Button with very minute remnants of flange stumps	I, 8					Several etch pits and a few flow lines (some pits = possibly exposed bubbles up to 1·1 mm across)
120	Small oval with worn bubble crater	II, 34	Rim present (worn)		6 mm across, 0·5 mm deep on posterior surface		Few flow lines and minute etch pits
121	Small oval with small worn bubble crater	II, 31	,, ,,		3·5 mm across, 0·8 mm deep on posterior surface		Smoothed by abrasion, few remnant etch grooves and rare etch pits
122	Small oval ('pip-like')	II, 33					Smoothed by abrasion, few remnant etch grooves and rare etch pits

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery, depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
123	Small teardrop	IV, 37	Small remnant of thin flange	Worn away			Complex fold-like flow line pattern on gibbosity; flow lines trend into attenuated end. Shows high etch lustre
124	Oval conical core (Shape due to terrestrial erosion)	II, 28	7·0				Contorted flow-lines, some etch pits on posterior surface. Other surfaces smoother but finely etch-pitted
125	„ „	II, 24	5·5				Smoothed by abrasion; several etch pits and exposed bubbles as pits, but few flow lines evident
126	Eroded oval core	II, 23	6·1				Finely etch-pitted, somewhat abraded, few flow lines
127	Teardrop	IV, 32					Abraded, but with remnants of etch pits (worn) and flow lines from previous etching
128	Oval core (conical)	II, 29	7·0				Few flow lines; several pits (small etch pits and larger bubble pits up to 1·5 mm across and shallow)
129	Oval core	II, 20	5·6		One = 4·6 × 4·0 on fracture surface at one edge (1·0 mm deep)		Abraded, but with flow line, flow groove and etch pit remnants

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery, depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
130	,, ,,	II, 27	5·6				Smoothed by abrasion, but showing one or two remnant flow grooves, several etch pits and 'collisional bruise marks'
131	Oval	II, 30	Small worn remnant of flange stump	Worn and vague but discernible as anti-clockwise spiral			Flow lines and etch pits on both surfaces
132	Canoe	III, 32	Worn, narrow zone (0·1 mm)	Longitudinal, worn, wrinkled in equatorial regions			Attenuated ends = 2·3 and 2·7 mm wide, but are broken. Complex flow line pattern on both surfaces, flow lines trend into the attenuations; few etch pits
133	Boat	III, 24	Worn rounded rim				Flow ridges and etch pits on posterior surface, etch pits on anterior surface
134	Slender teardrop	IV, 34	Rim present				Abraded; few remnant flow lines and etch pits. Attenuated end broken and worn; end of gibbosity with fracture facet
135	Small teardrop	IV, 36	Rim present and rare remnant stump of flange	Vague remnant around stagnation point is concentric			Complex, fold-like pattern of flow lines trend into attenuated end. Several fine etch pits on both surfaces

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery, depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
136	” ”	IV, 38	Worn rim present				Posterior surface nearly flat. Complex fold-like pattern of flow lines, some of which trend into attenuated end. A few etch pits. In part abraded
137	Teardrop	IV, 33	Flange remnant = 1·8 wide, but is worn	Worn, concentric around stagnation point			Complex pattern of flow lines, some of which twist across the attenuated end. Several etch pits and some flow lines over-deepened by etching
138	Lens	I, 6	Rim present	Worn, concentric			Complex, fold-like pattern of flow lines, on posterior surface, with few etch pits. Anterior surface with flow lines and etch pits and rare, minute höfchen and tischschen structures. 'Saw-mark' extends from pole to pole across anterior and posterior surfaces
139	Oval core	II, 19	9·0 (incomplete around form)				Flow lines; pits up to 2·3 mm across
140	Oval core (conical)	II, 9	9·3				Fine flow lines and etch pits
141	” ”	II, 10	14·1				Smoothed by abrasion; with few remnant etch pits and rare lunate 'chatter-marks'
142	” ”	II, 25, 26	14·5				Few flow lines and etch pits, mainly smoothed by abrasion

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery, depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
143	Oval core (conical)	II, 16	11·7		Round; 3·3 mm across and 1·2 mm deep on posterior surface	14·9 mm across on posterior surface	Flow lines, etch pits (some elongated)
144	,, ,,	II, 22	8·7				Few flow lines and etch pits; generally smoothed by abrasion
145	Broken round core	III, 6	12·8		Exposed internal cavity = round, 5 mm across		Abraded and smoothed most parts of outer and fracture surfaces. Few fine flow lines, occasional etch pits, a few lunate 'chatter-marks'
146	Broken boat core	III, 12	6.3 Worn, on one side only		Exposed internal cavity on fracture surface = 11·5 ×9·9 across (2 mm deep)		Smoothed by abrasion, but with remnant fine flow lines and small etch pits. Flow lines on fracture surface concentric with rim of cavity
147	Teardrop core	IV, 24	14·3 worn				Exposed internal bubble on f.e.z.§ = 2·2 mm across. Smoothed by abrasion; few remnant flow grooves worn and trend into tail. Few etch pits. 'Saw-marks' (= etch grooves) cross from distal edge of posterior surface to top end of f.e.z.§

§ Flaked equatorial zone.

TABLE 7—*continued*

Collection Number	Shape Type	Plate Number	Nature of periphery, depth of flaked equatorial zone where present (mm)	Flow ridges on anterior surface	Surficial bubble craters	Flow swirls on posterior surface	Remarks
148	Teardrop core	IV, 25	15·6				Abraded; few etch pits and flow lines, some of which twist into the attenuated tail end. 2 or 3 'navel' structures resemble 'höfchen' and 'tischschen' structures

Flaked equatorial zone depth measurements are average value for each form, i.e. these zones are not always the same depth all around the circumference of a particular specimen, the depth values varying from 0·5 mm to 1·0 mm each side of the average.

30). The cavity depth of the broken hollow button illustrated in Pl. 9, fig. 3 is 7·3 mm. Since the depth of the specimen is 10·6 mm from the front pole to the broken back surface, the thickness of the front wall in its present aerodynamically ablated and partially terrestrially eroded state is 3·3 mm. Originally it was probably at least twice this thickness before the onset of aerodynamic ablation of the primary hollow form. The thickness of the rear wall has been calculated from diagrammatically reconstructing the original form as being a little under 0·5 mm; this is very thin, hence its failure to resist terrestrial erosion and persist as a complete, unbroken hollow australite.

As gauged from the specific gravity values listed in Table 1, it becomes evident that none of the specimens contain unbroken internal bubbles of a size warranting their classification as true unbroken hollow forms. The lowest specific gravity of 2·348 is for a teardrop-shaped form (Table 1, 98, Pl. 12, fig. 27) in which one or two enclosed bubbles in the size range below 2 mm diameter may be responsible for lowering the specific gravity 0·057 below the average value. Alternatively, the specimen may contain a number of scattered, even smaller internal bubbles. Holding this teardrop-shaped specimen against a strong beam of light failed to reveal the internal translucency shown by hollow forms with distinctly lower specific gravity values.

Some specimens reveal surficial bubble craters 2·5 mm and over in diameter (Table 7). These sometimes occur on the posterior surface (e.g. Pl. 9, 29; Pl. 10, 2, 31; Pl. 12, 6), sometimes on the anterior surface (e.g. Pl. 11, 12). They are not as deep as in the more distinctly broken hollow forms (e.g. Pl. 9, 3; Pl. 12, 30), and apparently represent the sites of gas bubbles of intermediate size (approximately 2·5 mm-5·0 mm in diameter) that may have burst at the surface of the tektite during formation at the extraterrestrial birthplace. Terrestrial erosion has subsequently worn down and modified the rims and walls of these intermediate bubble depressions.

Smaller pits on the surfaces of several of the specimens (e.g. Pl. 9, 10, 12, 29, 35; Pl. 10, 3, 11, 19, 21; Pl. 11, 2, 3, 4, 8, 13; Pl. 12, 6, 17, 19, 23, 24) were probably largely produced by differential solution-etching during burial in moist soils. Embedded in some of these pits, also jammed in or sometimes partially cemented along a few of the solution etch grooves and etched-out schlieren, and occurring in parts of the few flange-core boundaries still extant, there occurred occasional light-brown to red and brownish lateritic constituents comparable with the soils in the region of discovery. The colour variation of these embedded terrestrial soil constituents arises from differential leaching of the natural rust components (ferric oxide and ferric hydroxide) from place to place. The soil particles lodged in certain of the deeper parts of the sculpture pattern of the australites are mostly the finer fractions of ferruginous clay material carrying occasional small, well-rounded detrital grains of quartz ranging up to 0·5 mm across. These constitute the adventitious materials that were removed on cleaning the australites preparatory to weighing and determination of the individual specific gravity values.

Collisional bruising of some of the specimens has produced incipiently-formed to more specifically defined chatter-marks of lunate to sub-circular outline on some of these worn australites (e.g. Pl. 10, fig. 4, left-hand side of photograph, and Pl. 11, fig. 2, top left portion of photograph), and these have been further weathered to different degrees. In these 'bruise-mark' structures occur small areas where very thin flakes are tending to lift up, and minor amounts of the ferruginous clay constituents of the soil have filtered in to form thin films under parts of the bruised

portions of the tektite glass. Evidently collisional bruising of some specimens has arisen fortuitously during limited distances of transportation of australites and other constituents of lag deposits across the deflated areas constituting the bare ground on which they were found. Smaller, less frequent collisional 'bruise-marks' may have resulted from the impact of smaller stones or granules washed against the australites during run-off of rainwater on local gently sloping parts of the surface where they were found.

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Explanation of Plates

PLATE 9

Fig. 1-46—Eroded round forms of australites from near Morgan, S.A. 1—posterior surface and 2—anterior surface of the same flanged australite button; 3—posterior surface and 4—anterior surface of the same broken hollow form (4 reveals worn remnants of flow ridges); 5-6—posterior surfaces of lens-shaped forms; 7-8—anterior surfaces of two different button cores from which the flange has been shed; remainder 9-46—posterior surfaces of worn, mainly smoothed round cores sometimes with small craters (29), chipped edges (33) and flow lines and etch pits (20, 43, 45). Photographs, natural size, by N. Philip.

PLATE 10

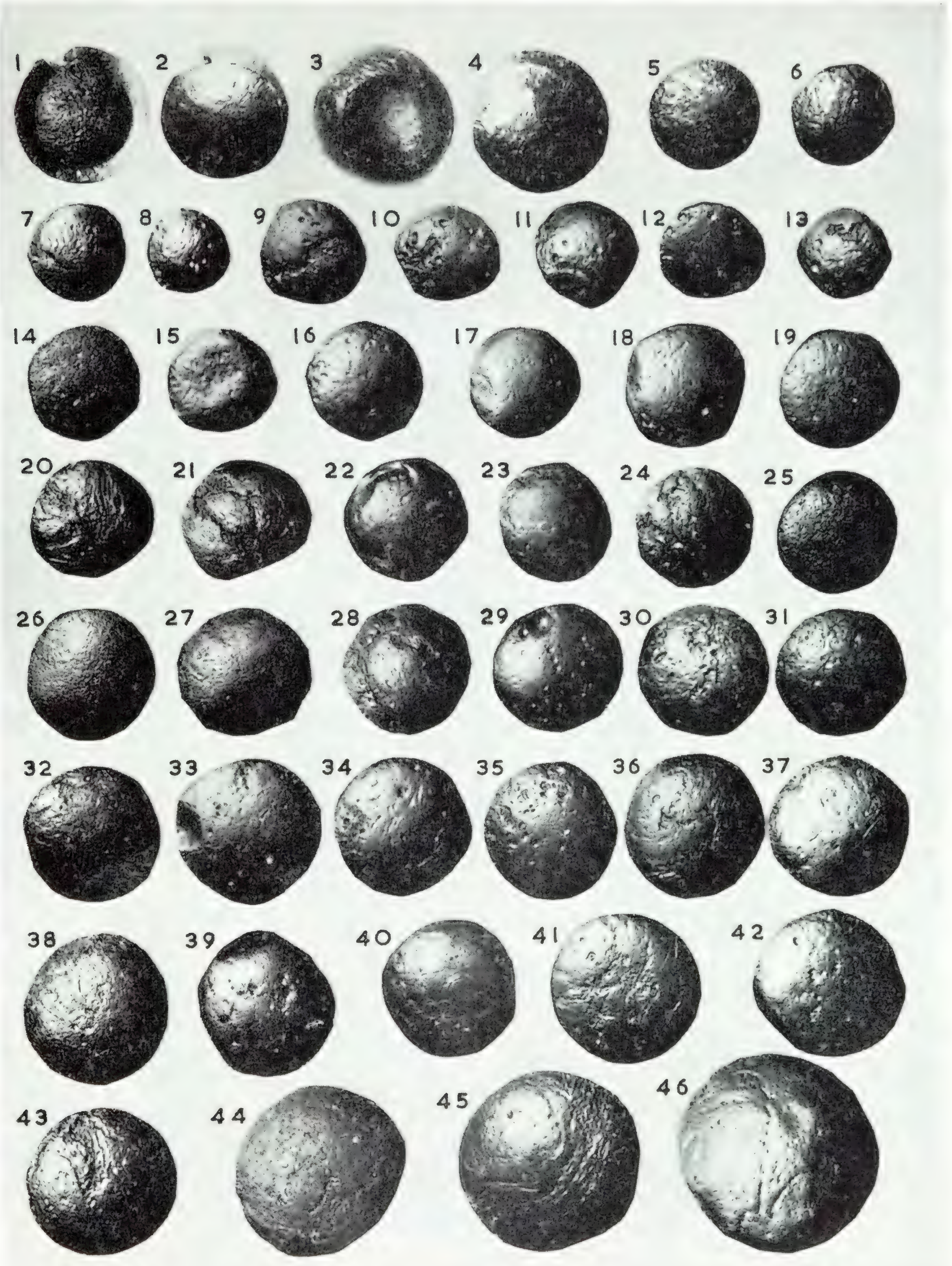
Fig. 1-34—Eroded oval forms of australites from near Morgan, S.A. 1, 3 reveal flow swirls; 2, 31 show surficial bubble craters while 34 possesses a large bubble crater on the posterior surface of a small form; 26 is an end-on view to show the conical core type of outline, with flaked equatorial zone showing on each side. Irregularity of outline in plan aspect of some forms (e.g. 16, 23, 25, 27, 28, 30) is due to erosion and fracture. Photographs, natural size, by N. Philip.

PLATE 11

Fig. 1-34—Eroded round forms (1-6), boat-shaped forms (7-31), and canoe-shaped form (32-34) of australites from near Morgan, S.A. 3, 4 reveal flow swirls; 9, 10, 27 show flow lines; 12 shows a large bubble crater (at top of photograph); 19 shows distinct flange remnants but 14, 17, 18 show only remnants of flange stumps and flange band; 6—side view of a broken form; 32—posterior surface; 33—side view, and 34—anterior surface of the same canoe-shaped form, with narrow flange (32) and remnants of flow ridges (33). Some of the boats are broader forms (e.g. 7), others are more slender for their length (e.g. 8, 26, 27). Unless otherwise stated, posterior surfaces are shown. Photographs, natural size, by N. Philip.

PLATE 12

Fig. 1-38—Eroded dumbbell-shaped forms (1-16), 'peanut-like' forms (17-20), oval 'nut-like' form (21), and teardrop-shaped to pear-shaped forms (22-38) from near Morgan, S.A. Nos. 2, 4, 5, 8, 25, 28 show poorly marked flow lines; 6, 30 show exposed internal bubble cavities; 26—side view of gibbosity of teardrop-shaped form and detached attenuated tail of a teardrop-shaped form (probably from two different but allied specimens); 31, 33 show small remnants of the flange at the broader end of the gibbosity; the constricted waist region of the dumbbell-shaped forms varies from broad and stout (e.g. 1, 2, 7) to narrow and slender (e.g. 5, 6); 11 reveals minute remnants of the flange structure in the waist regions; a star-shaped erosion sculpture pattern is shown by 29. Photographs, natural size, by N. Philip.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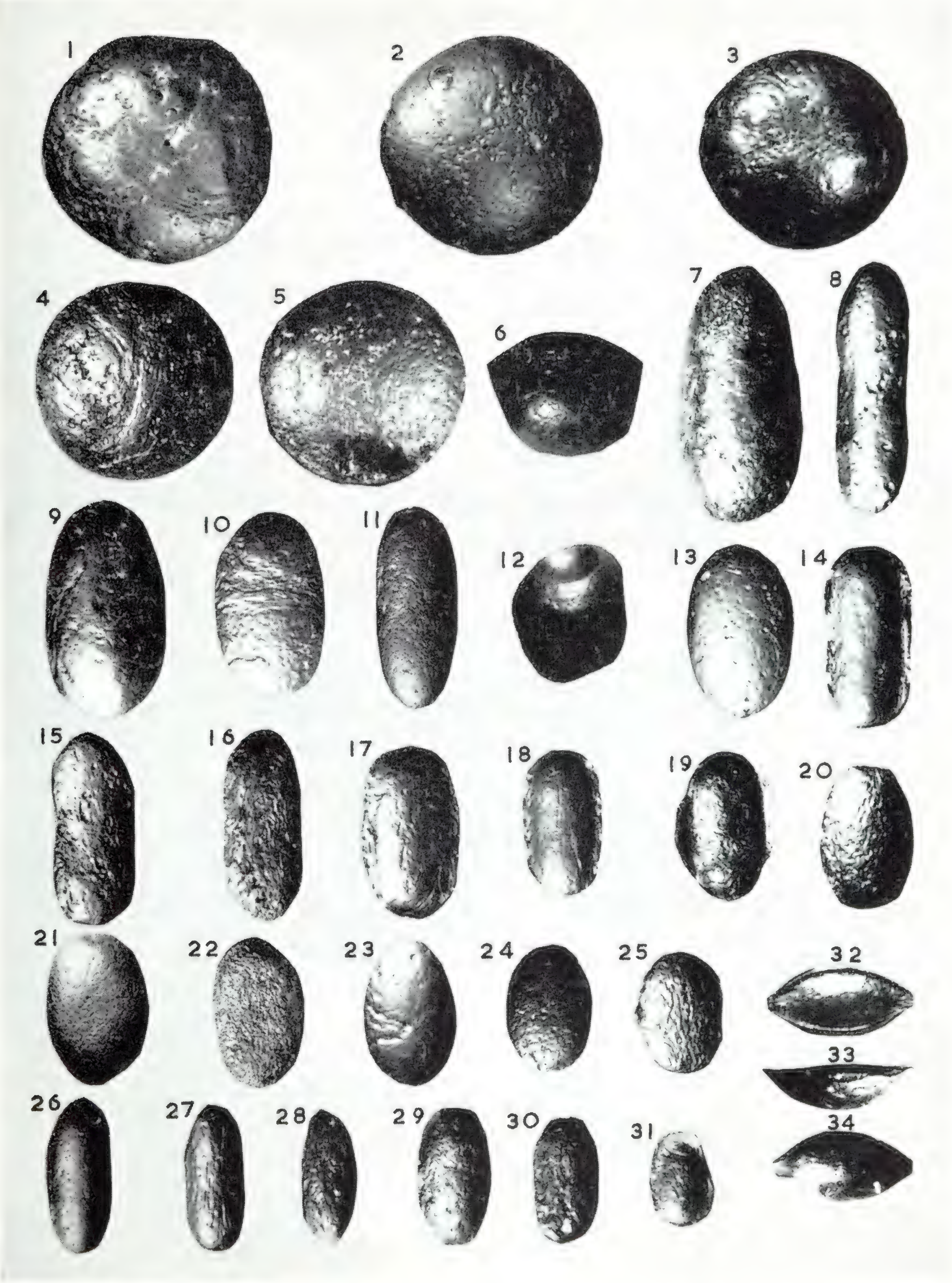
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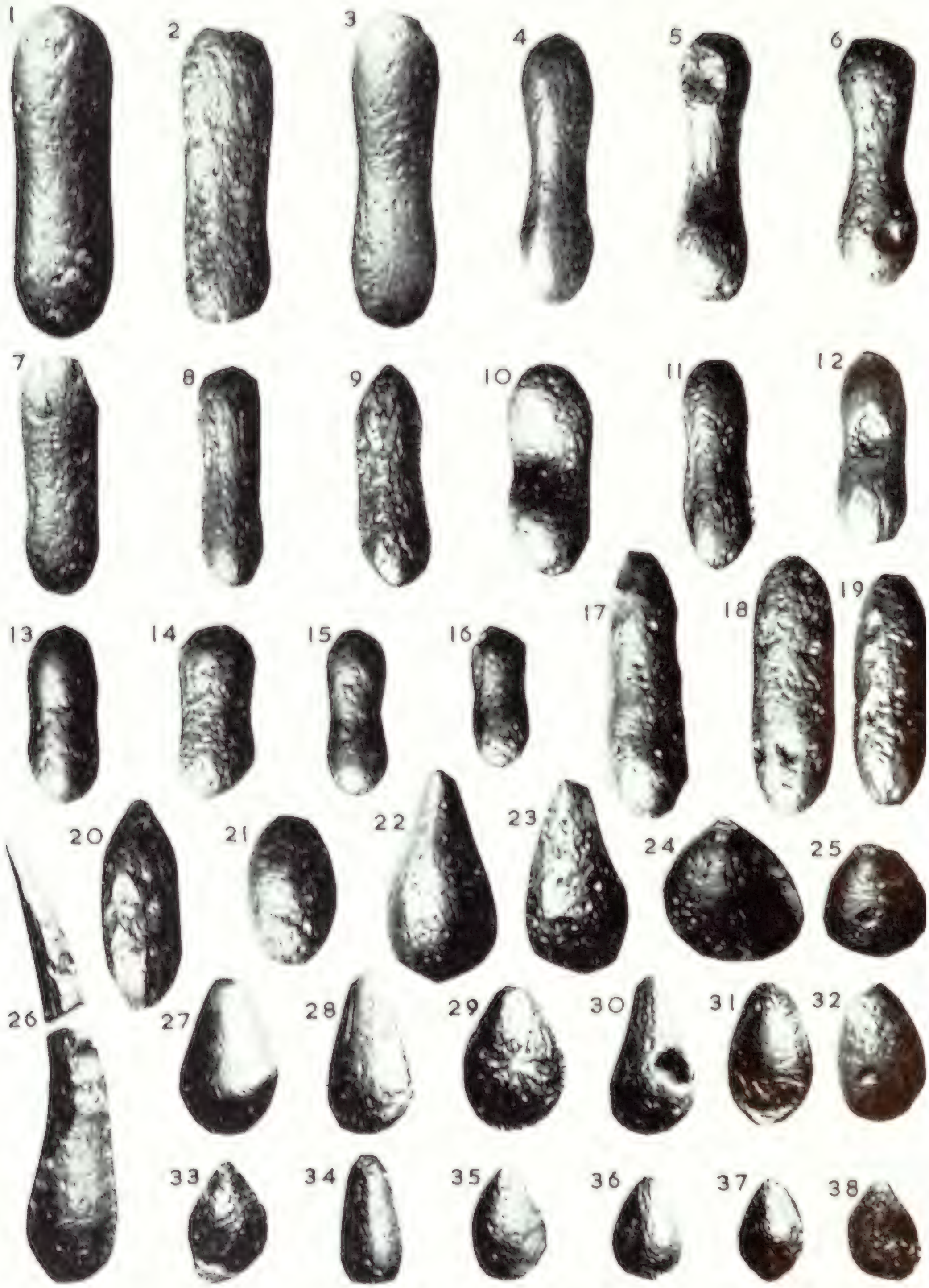
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CATALOGUE OF MIDDLE PALAEOZOIC TYPES AND FIGURED SPECIMENS IN THE NATIONAL MUSEUM OF VICTORIA, PART 2

By EDMUND D. GILL, Assistant Director
and ETHEL M. DAVIES

Class Carpoidea

Rutroclypeus junori Withers. P 13681
Lower Devonian.
Collins' Quarry. 1½ miles NW. of Kinglake West P.O., on the W. bank of King Parrot Ck where crossed by the N. boundary of the Parish of Kinglake, Victoria.
Mil. Map Kinglake Sheet, Grid Ref. 254, 799.
Holotype.
Withers, R. B., 1933. *Proc. Roy. Soc. Vict.* 45: 18-22, Pl. 5, fig. 1, text fig. p. 20.
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 1, fig. 1, 3, text fig. 6.

Rutroclypeus junori Withers. P 13682
Lower Devonian.
Collins' Quarry, Kinglake West, Victoria.
Paratype.
Withers, R. B., 1933. *Proc. Roy. Soc. Vict.* 45: 18-22, Pl. 5, fig. 2.
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 2, fig. 2-3.

Rutroclypeus junori Withers. P 16792
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Hypotype.
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 1, fig. 2. Explanation of plate reads 'holotype' instead of 'hypotype'.

Rutroclypeus victoriae Gill and Caster. P 16441-2
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Holotype (Counterparts. P 16441 antianal surface. P 16442 anal surface).
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 2, fig. 1 (antianal surface), Pl. 3, fig. 2 (latex cast of antianal surface), Pl. 4, fig. 1 (anal surface), Pl. 5, fig. 1 (latex cast of anal surface), Pl. 7 (stereoscopic pair of latex cast of antianal surface), text fig. 2, 8.

Rutroclypeus victoriae Gill and Caster. P 16443-4
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Paratype A (P 16443 figured; counterpart P 16444).
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 4, fig. 2, 3 (latex cast).

Rutroclypeus victoriae Gill and Caster. P 16883-4
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Paratype B (counterparts, P 16884 figured).
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 3, fig. 3.

Rutroclypeus victoriae Gill and Caster. P 16451
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Figured specimen.
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 3, fig. 1.

Rutroclypeus victoriae? Gill and Caster. P 17423
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Figured specimen.
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 4, fig. 4 (latex cast), 5.

Rutroclypeus (?) withersi Gill and Caster. P 16452-3
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Holotype (External moulds of portions of the anal and antianal surfaces).
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 5, fig. 2 (latex cast), 3.

Rutroclypeus (?) withersi Gill and Caster. P 16450-1
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Paratype (counterparts).
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 5, fig. 4; Pl. 6, fig. 1.

Victoriacystis wilkinsi Gill and Caster. P 16787-8
Upper Silurian.
Locality F41-42, Dargile Beds, Parish of Heathcote, Victoria.
Holotype. (P 16787 carapace, P 16788 plastron.)
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 8, fig. 1, 2 (latex cast of plastron); Pl. 9, fig. 2 (carapace); Pl. 10, fig. 2 (latex cast of carapace), text fig. 11.

Victoriacystis wilkinsi Gill and Caster. P 16904
Upper Silurian.
Locality F41-42, Dargile Beds, Parish of Heathcote, Victoria.
Paratype.
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 9, fig. 1 (latex cast).

Victoriacystis aff. *wilkinsi* Gill and Caster. P 16880-1
Lower Devonian.
Middendorp's Quarry, Kinglake West, Victoria.
Figured specimen (P 16880 carapace, P 16881 plastron).
Gill, E. D., and Caster, K. E., 1960. *Bull. Amer. Paleont.* 185, Pl. 10, fig. 1 (latex cast), 3.

Class Asteroidea

Baliactis flemingtonensis (Withers and Keble). P 13813
Upper Silurian (Melbournian).
Flemington (= Moonee Ponds Creek), Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 11, fig. 3, text fig. 7. '*Palasterina flemingtonensis*'.
Spencer, W. K., 1950. *Geol. Mag.* 77: 393-408.

Eoactis stachi (Withers and Keble). P 13811
Upper Silurian (Melbournian).
Corner of Collins Place and Flinders Street, Melbourne, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 11, fig. 4. '*Palasterina stachi*'.
Spencer, W. K., 1950. *Geol. Mag.* 77: 393-408.

Eoactis stachi (Withers and Keble). P 13812
Upper Silurian (Melbournian).
Corner of Collins Place and Flinders Street, Melbourne, Victoria.
Paratype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 11, fig. 6. '*Palasterina stachi*'.

Lepidaster australis (Withers and Keble). P 13805-6
Silurian.
Cutting on Yan Yean to Arthur's Creek Road, $\frac{1}{3}$ mile E. of junction to Doreen, Victoria. Mil. map Ref. 178, 660.
Holotype (counterparts, P 13806 figured. 'Syntypes' of Withers and Keble).
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 10, fig. 6, text fig. 1, 3. '*Hudsonaster australis*'.
Spencer, W. K., 1950. *Geol. Mag.* 77: 393-408.

Lepidaster australis Withers and Keble. P 13807
Silurian.
Cutting on Yan Yean to Arthur's Creek Road, $\frac{1}{3}$ mile E. of junction to Doreen, Victoria. Mil. map ref. 178, 660.
Paratype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, '*Caractacaster yarraensis*'.

Palasterina umbonata Withers and Keble. P 13810
Silurian.
Near Plenty Ranges, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 10, fig. 4.

Petraster angustior Withers and Keble. P 374
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 12, fig. 4, text fig. 6.

Petraster angustior Withers and Keble. P 372
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 12, fig. 5.

Petraster smythi McCoy. P 7604
Upper Silurian (Melbournian).
Moonee Ponds Creek, Flemington, Victoria.
Holotype.
McCoy, F., 1874. *Prod. Pal. Vict.* Dec. 1: p. 41, Pl. 10, fig. 1-1b (figures reversed).
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 12, fig. 2.

Petraster smythi McCoy. P 13815
Silurian.
Kilmore East, Victoria.
Hypotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 12, fig. 1 (plasticine cast).

Phillipsaster selwyni (McCoy). P 12207-8
Silurian.
Range on E. side of Commonage, Kilmore, Victoria.
Holotype (counterparts, 'syntypes' of Withers and Keble).
McCoy, F., 1874. *Prod. Pal. Vict.* Dec. 1: 42-43, Pl. 10, fig. 2-2*a* (P 12208), fig. 3-3*a* (P 12207), (figures reversed). '*Urasterella selwyni*'.
Chapman, F., 1914. Australasian Fossils. 8vo. Melbourne, fig. 77B.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 11, fig. 1 (P 12207), fig. 2 (P 12208). '*Salteraster selwyni*'.
Spencer, W. K., 1950. *Geol. Mag.* 77: 393-408.

Promopalaeaster meridionalis parvior Withers and Keble. P 13816
Upper Silurian (Melbournian).
Moonee Ponds Creek, Flemington, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 10, fig. 5.

Schuchertia junori Withers and Keble. P 13808
Lower Devonian (Yeringian).
Collins' Quarry, Kinglake West, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 10, fig. 3.
Spencer, W. K., 1950. *Geol. Mag.* 77: 393-408.

Schuchertia macrarta Withers and Keble. P 13809
Upper Silurian (Melbournian).
Hoffman Brick Pit, Brunswick, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 12, fig. 3, text fig. 8.
Spencer, W. K., 1950. *Geol. Mag.* 77: 393-408.

Ulrichaster biradialis (Withers and Keble). P 352
Silurian.
Range on E. side of Commonage, Kilmore, Victoria.
Holotype.
Withers, R. B,. and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 11, fig. 5, text fig. 10. *'Salteraster biradialis'*.
Spencer, W. K., 1950. *Geol. Mag.* 77: 393-408.

Ulrichaster biradialis (Withers and Keble). P 355
Silurian.
Range on E. side of Commonage, Kilmore, Victoria.
Paratype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, text fig. 9. *'Salteraster biradialis'*.

Urasterella cresswelli Withers and Keble. P 13817
Lower Devonian (Yeringian).
Mudstone Quarries, Lilydale, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 12, fig. 6.

Yarravaster yarraensis Withers and Keble. P 377
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype and Paratype (on one slab).
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 46: 220-249, Pl. 10, fig. 1-2, text fig. 2, 4. *'Caractacaster yarraensis'*.
Spencer, W. K., 1950. *Geol. Mag.* 77: 393-408.

Class Crinoidea

Botryocrinus longibrachiatus Chapman. P 390
Upper Silurian (Melbournian).
Royal Park, Brunswick, Victoria.
Lectoholotype.
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 15: 104-122, Pl. 18, fig. 6 (wax cast).
Bather, F. A., 1906. *Ottawa Nat.* 20 (5): 93-104.

Botryocrinus longibrachiatus Chapman. P 391-2
Upper Silurian (Melbournian).
Royal Park, Brunswick, Victoria.
Lectoparatypes.
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 15: 104-122, Pl. 18, fig. 7 (P 392), 8 (P 391 wax cast).
Bather, F. A., 1906. *Ottawa Nat.* 20 (5): 93-104.
Chapman, F., 1914. Australasian Fossils. 8vo. Melbourne. Fig. 76 C (P 392).

Hapalocrinus victoriae Bather. P 386
Upper Silurian (Melbournian). P 10307
Near Princes Bridge, Melbourne, Victoria.
Holotype (P 386; counterpart P 10307).
Bather, F. A., 1897. *Geol. Mag.* Dec. 4 (4): 337-345, Pl. 15 (P 386).

Helicocrinus plumosus Chapman. P 384-5
Upper Silurian (Melbournian).
Quarry between Albert and Victoria Streets, West Brunswick, Victoria.
Holotype (P 384, fragmentary counterpart P 385). Type species of genus.
Chapman, F., 1903. *Proc. Roy. Soc. Vict.* 15: 104-122, Pl. 17 (P 384), Pl. 18, fig. 1-3, 5 (P 384) 4 (P 385).
Chapman, F., 1914. Australasian Fossils. 8vo. Melbourne.
Frontispiece (P 384), fig. 76D (P 385).

Lecanocrinus breviarticulatus Chapman. P 13897
Silurian.
Hatton's Corner, Yass, New South Wales.
Holotype.
Chapman, F., 1934. *Proc. Roy. Soc. Vict.* 47: 190-195, Pl. 10, fig. 1-6.

Crinoid Columnal 1. P 14843
Silurian (Crotty Quartsite).
Sand quarry on Smelter's Ridge, SE. of Zeehan, Tasmania.
Figured specimen.
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for 1949*: 231-258, Pl. 1, fig. 40.

Crinoid Columnal 2. P 14822
Lower Devonian (Bell Shale).
Right bank Little Henty River, 1 mile SE. of Zeehan, Tasmania.
Figured specimen.
Gill, E. D., 1950. *Pap. & Proc. Roy. Soc. Tas. for 1949*: 231-258, Pl. 1, fig. 41.

Class Ophiuroidea

Crepidosoma kinglakensis Withers and Keble. P 13831
Lower Devonian.
Collins' Quarry, Kinglake West, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212, Pl. 11, fig. 3, text fig. 2.

Crepidosoma kinglakensis Withers and Keble. P 13832
Lower Devonian.
Collins' Quarry, Kinglake West, Victoria.
Paratype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212, text fig. 3.

Furcaster kilmorensis Withers and Keble. P 13829
Silurian.
Kilmore, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212, Pl. 11, fig. 8, text fig. 6.

Furcaster kilmorensis Withers and Keble. P 13830
Silurian.
Kilmore, Victoria.
Paratype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212, text fig. 7.

Furcaster leptosomoides Chapman. P 9104
Upper Silurian (Melbournian).
Moonee Ponds Creek, Flemington, Victoria.
Holotype.
Chapman, F., 1907. *Proc. Roy. Soc. Vict.* 19: 21-27, Pl. 7, fig. 1; Pl. 8, fig. 4. '*Sturtzura leptosomoides*'.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212.

Furcaster leptosomoides Chapman. P 9103
Upper Silurian (Melbournian).
Moonee Ponds Creek, Flemington, Victoria.
Paratype.
Chapman, F., 1907. *Proc. Roy. Soc. Vict.* 19: 21-27, Pl. 7, fig. 2. '*Sturtzura leptosomoides*'.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212.

Gregoriura spryi Chapman. P 9105
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype.
Chapman, F., 1907. *Proc. Roy. Soc. Vict.* 19: 21-27, Pl. 6, fig. 1, text fig. Pl. 8, fig. 1, 3.
Chapman, F., 1914. Australasian Fossils. 8vo. Melbourne. Fig. 79.

Lapworthura miltoni Salter. P 13833
Lower Devonian.
Collins' Quarry, Kinglake West, Victoria.
Hypotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212, Pl. 11, fig. 4.

Sturtzura brisingoides (Gregory). P 368
Upper Silurian (Melbournian).
Flemington, Victoria.
Hypotype.
Chapman, F., 1907. *Proc. Roy. Soc. Vict.* 19: 21-27, Pl. 6, fig. 2; Pl. 8, fig. 2. '*Protaster brisingoides.*'
Chapman, F., 1914. Australasian Fossils. 8vo. Melbourne. Fig. 78.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212.

Taeniactis yeringae Withers and Keble. P 13827
Lower Devonian.
Section 12, Parish of Yering, Victoria.
Holotype.
Withers, R. B., and Keble, R. A., 1934. *Proc. Roy. Soc. Vict.* 47: 196-212, text fig. 1.

Class Cephalopoda

Danaoceras (?) bindiense Teichert. P 1293
Middle Devonian.
Bindi, Gippsland, Victoria.
Holotype.
Teichert, C., 1940. *J. Roy. Soc. W.A.* 26: 59-67, Pl. 1, fig. 1; Pl. 4, fig. 10, 12.

Geisonocerina australis (Chapman). P 12885-6
Silurian.
1½ Miles SW. of Kelly's Hill, Yarra Track, Wood's Point, Victoria.
Holotype (P 12885; counterpart P 12886).
Chapman, F., 1912. *Rec. Geol. Surv. Vict.* 3 (2): 232-233, Pl. 38, fig. 3-4.
'Cycloceras tenuiannulatum var. *australis.'*
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752.

'Kionoceras striato-punctatum (Münster).' P 12124
Lower Devonian.
Reefton, near Warburton, Victoria.
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 28-29, Pl. 57, fig. 7.
'Orthoceras striato-punctatum.'
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. *Kionoceras* sp. nov.

'Kionoceras striato-punctatum (Münster).' P 12125
Lower Devonian.
McMahon's Creek, Upper Yarra, Victoria.
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 28-29, Pl. 57, fig. 7a.
'Orthoceras striato-punctatum.'
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. *Kionoceras* sp. nov.

'Kionoceras striato-punctatum (Münster).' P 12126
Lower Devonian.
McMahon's Creek, Upper Yarra, Victoria.
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 28-29, Pl. 57, fig. 8.
'Orthoceras striato-punctatum.'
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. *Kionoceras* sp. nov.

'Orthoceras (Cycloceras) idex (Sowerby).' P 12121
Silurian.
Kilmore Creek, N. of the Special Survey, (Bb 20) Victoria.
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 25-26, Pl. 57, fig. 1-1a (figures reversed).
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. *Dawsonoceras?* sp. indet.

'Orthoceras (Cycloceras) ibex (Sowerby).' P 12122
Silurian.
Specimen marked A1, (probably Moonee Ponds Ck, Victoria).
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 25-26, Pl. 57, fig. 2 (figure reversed).
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. *Dawsonoceras?* sp. indet.

'Orthoceras bullatum Sowerby.' P 12127
Upper Silurian (Melbournian).
Johnston Street, Collingwood, Victoria.
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 26-27, Pl. 57, fig. 4-4b (figures reversed).
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. Gen. et sp. indet.

'Orthoceras bullatum Sowerby.' P 12129
Silurian.
Hills in township of Whittlesea (B12), Parish of Toorourrong, Victoria.
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 26-27, Pl. 57, fig. 3-3b (figures reversed).
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. Gen. et. sp. indet.

'Orthoceras capillosum Barrande.' P 12123
Silurian.
Broadhurst's Creek, E. of Kilmore, Victoria.
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 27, Pl. 57, fig. 5-5b (figures reversed).
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. Gen. et. sp. indet.

'Orthoceras lineare Münster.' P 12128
Lower Devonian.
Junction of Woori Yallock Creek and Yarra River, Victoria.
Hypotype.
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6: 28, Pl. 57, fig. 6-6b.
Gill, E. D., 1951. *Proc. Roy. Soc. Vict.* 63: 35. Orthoceracone indet.
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752. Gen. et. sp. indet.

Pectinoceras subtrigonum (McCoy). P 1290
Middle Devonian.
Buchan, Victoria.
Holotype.
McCoy, F., 1876. *Prod. Pal. Vict.* Dec. 4: 16-17, Pl. 35, fig. 6-6b.
'Phragmoceras subtrigonum.'
Teichert, C., 1940. *J. Roy. Soc. W.A.* 26: 59-67, Pl. 3, fig. 7-9.
Danaoceras subtrigonum.
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752.

Pectinoceras subtrigonum (McCoy). Slide P 1291
Middle Devonian.
Buchan, Victoria.
Tectohypotype.
Teichert, C., 1940. *J. Roy. Soc. W.A.* 26: 59-67, Pl. 4, fig. 11.
'Danaoceras subtrigonum.'
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752.

Pectinoceras subtrigonum McCoy. P 15373
Middle Devonian.
Buchan, Victoria.
Hypotype.
Teichert, C., 1940. *J. Roy. Soc. W.A.* 26: 59-67, text fig. 2.
'Danaoceras subtrigonum.'
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752.

P 12936

'? Protophragmoceras sp.' Slide P 12937
P 21778

Lower Devonian.
Griffith's Quarry, Loyola, Victoria.
Figured specimen.
Chapman, F., 1914. *Rec. Geol. Surv. Vict.* 3 (3): 312, Pl. 61, fig. 38-39 (P 12936).
Teichert, C., and Glenister, B. F., 1952. *J. Paleont.* 26: 730-752.
'After a study of the object itself we are not convinced of its cephalopod, or indeed fossil, nature.'

Class Lamellibranchiata

Actinodesma cf. *ampliata* (Phillips). P 2267
Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Figured specimen (external mould).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 87.

Actinopteria boydi (Conrad). P 7933-4
Lower Devonian (Yeringian).
Wilson's Quarry, near Lilydale, Victoria.
Hypotype (steinkern P 7933; external mould P 7934).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 69 (P 7933).

Actinopteria boydi Conrad. P 7935
Lower Devonian (Yeringian).
Croydon, Victoria = Kilsyth (Gill 1940).
Hypotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 5, fig. 70.

P 7936

Actinopteria asperula croydonensis Chapman. P 22545
Lower Devonian (Yeringian).
'Croydon, Victoria' = Kilsyth.
Holotype (steinkern P 7936; fragment of external mould P 22545) of subspecies.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 5, fig. 71 (P 7936).

Actinopteria heathcotiensis Chapman. P 7938
Silurian or Lower Devonian.
East of Heathcote, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 5, fig. 73.

Actinopteria cf. *sowerbii* (McCoy). P 7937
Upper Silurian or Lower Devonian.
Reefton, near Warburton, Victoria.
Figured specimen (external mould).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 5, fig. 72 (of wax impression).

Actinopteria texturata (Phillips). P 2264
Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Hypotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 68-68A.

Ambonychia acuticostata McCoy. P 2268
Lower Devonian (Yeringian).
Cave Hill, Lilydale, Victoria.
Hypotype.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 66.

'*Ambonychia tatei* Cresswell.' P 2269
Lower Devonian (Yeringian).
Cave Hill, Lilydale, Victoria.
Holotype.
Cresswell, A. W., 1893. *Proc. Roy. Soc. Vict.* 5: 38-44, Pl. 9, fig. 8.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 60. This author states 'There is very little doubt that the imperfect valve figured under the name of *Ambonychia tatei* by the Rev. A. W. Cresswell is an example of *Pterinea lineata* Goldfuss'.

Aviculopecten spryi Chapman. P 7940
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (external mould).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 49-50, Pl. 5, fig. 75.

Cardiola cornucopiae (Goldfuss). P 978
Upper Silurian (Melbournian).
Royal Park = Moonee Ponds Creek, Flemington, Victoria.
Hypotype.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 12.

Cardiola cornucopiae (Goldfuss). P 7878
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Hypotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 11.

Conocardium bellulum Cresswell.
see *Conocardium cresswelli* Talent and Philip.

Conocardium costatum Cresswell. P 910
Lower Devonian (Yeringian).
Cave Hill, Lilydale, Victoria.
Holotype.
Cresswell, A. W., 1893. *Proc. Roy. Soc. Vict.* 5: 38-44, Pl. 9, fig. 5.
'*Pleurorhynchus (Conocardium) costatus*.'
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62.
Fletcher, H. O., 1943. *Rec. Aust. Mus.* 21 (4): 231-243, Pl. 13, fig. 1-2.

Conocardium cresswelli Talent and Philip. P 911
Lower Devonian (Yeringian).
Cave Hill, Lilydale, Victoria.
Holotype.
Cresswell, A. W., 1893. *Proc. Roy. Soc. Vict.* 5: 38-44, Pl. 9, fig. 6.
'Pleurorhynchus (Conocardium) bellulus.'
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62.
Conocardium bellulum.
Fletcher, H. O., 1943. *Rec. Aust. Mus.* 21 (4): 231-243, Pl. 13, fig. 3-4.
'Conocardium bellulum.'
Talent, J. A., and Philip, G. M., 1955. *Proc. Roy. Soc. Vict.* 68: 2-71.

Ctenodonta portlocki Chapman. P 7883
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 18.

P 7884
Ctenodonta portlocki Chapman. P 22546
Lower Devonian (Yeringian).
Wilson's Station near Lilydale, Victoria.
Paratype (steinkern P 7884; external mould P 22546).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 17 (P 7884).

Ctenodonta portlocki Chapman. P 7885
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 19.

Ctenodonta portlocki Chapman. P 7886
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 20.

Ctenodonta (Praectenodonta) raricostae (Chapman). P 17418
Lower Devonian (Yeringian).
Killara Tunnel, Killara, Victoria.
Hypotype (external mould of both valves).
Philip, G. M., 1962. *Proc. Roy. Soc. Vict.* 75: 123-244, Pl. 29, fig. 11, 17.

Cypricardinia contexta Barrande. P 2241-2
Lower Devonian (Yeringian).
Yering, Victoria.
Hypotype (steinkern, left valve, P 2242; external mould, P 2241).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 84 (P 2242).

Cypricardinia contexta Barrande. P 7946
Lower Devonian (Yeringian).
Croydon, Victoria = Kilsyth.
Hypotype (steinkern, right valve).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 82-83.

Edmondia perobliqua Chapman. P 7876
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 7.

Edmondia perobliqua Chapman. P 2239
Upper Silurian (Melbournian).
Domain Road sewer, South Yarra, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 9.

Edmondia perobliqua Chapman. P 7877
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 8.

Glossites victoriae Chapman. P 7944
Lower Devonian (Yeringian).
'Croydon, Victoria' = Kilsyth.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 79.

Goniophora australis Chapman. P 989
Lower Devonian (Yeringian).
North of Lilydale, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 80.

Goniophora cf. *glaucus* Hall. P 7945
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Figured specimen (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* Pl. 6, fig. 81.

Grammysia abbreviata Chapman. P 7871
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 2.

Hercynella killarensis Gill. P 14524
Lower Devonian (Yeringian).
Syme's Tunnel, Killara, Victoria.
Holotype (steinkern).
Gill, E. D., 1950. *Proc. Roy. Soc. Vict.* 59: 80-92, Pl. 7, fig. 3.
Prantl, F., 1960. *Paläont. Zeit.* 34 (2): 150-153.

Hercynella victoriae Chapman. P 12858
Lower Devonian.
Junction of Woori Yallock Creek and Yarra River, Victoria. G.S.V. B 23.
Holotype (steinkern).
Chapman, F., 1916. *Proc. Roy. Soc. Vict.* 29: 75-103, Pl. 5, fig. 47.
Gill, E. D., 1950. *Proc. Roy. Soc. Vict.* 59: 80-92, fig. 1*a*.

Hercynella victoriae Chapman. P 12857
Lower Devonian.
Junction of Woori Yallock Creek and Yarra River, Victoria. G.S.V. B 23.
Paratype.
Chapman, F., 1916. *Proc. Roy. Soc. Vict.* 29: 75-103, Pl. 5, fig. 48.
Gill, E. D., 1950. *Proc. Roy. Soc. Vict.* 59: 80-92.

Leiopteria cf. *oweni* Hall. P 7939
Lower Devonian (Yeringian).
Kilsyth, Victoria.
Figured specimen (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 5, fig. 74-74*a*.

Leptodomus heathcotiensis Chapman. P 987
Upper Silurian or Lower Devonian.
Ranges E. of Heathcote, Victoria, G.S.V. B*b* 50.
Holotype.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 5.

Leptodomus maccoyianus Chapman. P 976
Upper Silurian or Lower Devonian.
Broadhurst's Creek, E. of Kilmore, Victoria, G.S.V. B*b* 18.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 4.

Lunulicardium antistriatum Chapman. P 2257
Upper Silurian or Lower Devonian.
McMahon's Creek, Upper Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 62.

Lunulicardium antistriatum Chapman. P 2255
Upper Silurian or Lower Devonian.
Reefton, near Warburton, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 63-63*a*.

'? *Lunulicardium antistriatum* Chapman.' P 2261
Upper Silurian or Lower Devonian.
Mouth of Starvation Creek, Upper Yarra, Victoria.
Hypotypes ('young specimens').
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 64-65.

Modiolopsis nasuta australis Chapman. P 7943
Upper Silurian (Melbournian).
Domain Road, South Yarra, Victoria.
Holotype (steinkern, pair of valves) of subspecies.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 78.

Modiolopsis complanata (Sowerby). P 7942
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Hypotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 5, fig. 77.

Modiolopsis melbournensis Chapman. P 7941
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 5, fig. 76-76*a*.

Mytilarca acutirostris Chapman. P 7930
Lower Devonian (Yeringian).
Junction of Woori Yallock Creek and Yarra River, Victoria, G.S.V. B 23.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 67.

Nucula opima australis Chapman. P 7909
Upper Silurian (Melbournian).
North of Yan Yean, Victoria, G.S.V. B*b* 11.
Holotype of subspecies.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 40.

Nucula opima australis Chapman. P 965
Silurian (Melbournian).
Fraser's, or No. 3 Creek, Springfield, Victoria, G.S.V. B*b* 25.
Paratype of subspecies.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 42.

Nucula opima australis Chapman. P 7910
Upper Silurian (Melbournian).
North of Yan Yean, Victoria, G.S.V. B*b* 11.
Paratype of subspecies.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 39.

Nucula opima australis Chapman. P 7911
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype of sub-species.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 41.

Nucula opima australis Chapman. P 7912
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype of subspecies.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 43.

Nucula arcaeformis Chapman. P 7901
Upper Silurian (Melbournian).
Domain Road sewer, South Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 36.

Nucula lamellata Hall. P 2243
Upper Silurian (Melbournian).
Schist Hill, Merri Creek, Victoria, G.S.V. B*b* 6.
Hypotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 46.

Nucula lamellata Hall. P 2252
Upper Silurian or Lower Devonian.
Broadhurst's Creek, E. of Kilmore, Victoria, G.S.V. B*b* 18.
Hypotype (external mould).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 45.

Nucula cf. *lirata* (Conrad). P 7914
Upper Silurian (Melbournian).
Yan Yean, Victoria, G.S.V. B*b* 14.
Figured specimen.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 44.

Nucula melbournensis Chapman. P 7895
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 31.

Nucula melbournensis Chapman. P 7896
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 29.

Nucula ? melbournensis Chapman. P 7898 P 22571
Upper Silurian (Melbournian).
Domain Road, South Yarra, Victoria.
Figured specimen (steinkern P 7898 and external mould P 22571 of two valves).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 33-33*a*.

Nucula taylori Chapman. P 7907
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 37.

Nucula taylori Chapman. P 7908
'Silurian (Melbournian).'
Broadhurst's Creek, E. of Kilmore, Victoria. G.S.V. B*b* 18.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 38 (of wax impression).

Nucula umbonata Chapman. P 7899
Upper Silurian (Melbournian).
Police Paddock, Kilmore, Victoria, G.S.V. B2 22.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 34.

Nucula umbonata Chapman. P 7900
Upper Silurian (Melbournian).
South end of Reservoir, Yan Yean, Victoria, G.S.V. B*b* 14.
Paratype.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 35 (showing cardinal line and ligament pit).

Nuculites coarctatus (Phillips). P 7890
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Hypotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 24.

Nuculites coarctatus (Phillips). P 7891
'Silurian (Melbournian).'
Hills W. of Mount Disappointment, Victoria, G.S.V. B*b* 17.
Hypotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 25.

Nuculites jutsoni Chapman. P 7893
Upper Silurian.
Wandong, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 28.

Nuculites maccoyianus Chapman. P 7887
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern, two valves).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 21.

Nuculites maccoyianus Chapman. P 7888
Lower Devonian (Yeringian).
Junction of Woori Yallock Creek and Yarra River, Victoria, G.S.V. B23.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 22.

Nuculites maccoyianus Chapman. P 7889
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 23.

Nuculites subquadratus Chapman. P 7892
Upper Silurian (Melbournian).
North of Yan Yean, Victoria, G.S.V. B*b* 11.
Holotype.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 27-27*a*.

Nuculites subquadratus Chapman. P 977
'Silurian (Melbournian).'
West of Mount Disappointment, Victoria, G.S.V. B*b* 17.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 2, fig. 26.

Orthonota australis Chapman. P 7869
Upper Silurian (Melbournian).
'Royal Park' = Moonee Ponds Creek, Flemington, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 1.

Palaeanatina cf. *solenoides* Hall. P 7875
Upper Silurian (Melbournian).
South Yarra, Victoria.
Figured specimen.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 6.

Palaeoneilo cf. *brevis* Hall. P 968
Upper Silurian (Melbournian).
Merri Creek, sections 2 and 3, Kalkallo, Victoria. G.S.V. B*b* 3.
Figured specimen (external mould).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 55.

Palaeoneilo ? constricta (Conrad). P 7923
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Figured specimen (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 54.

Palaeoneilo producta Chapman. P 7921
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 53-53*a*.

Palaeoneilo raricostae Chapman.
see *Tancrediopsis raricostae* Chapman.

Palaeoneilo spectabilis Chapman. P 7919
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern, pair of valves, only one illustrated).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 51.

Palaeoneilo spectabilis Chapman. P 7920
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype (interior of left valve and cardinal area of right valve).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 52.

Palaeoneilo cf. *tenuistriata* Hall. P 967
Upper Silurian (Melbournian).
Merri Creek, sections 2 and 3, Kalkallo, Victoria, G.S.V. B*b* 3.
Figured specimen.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 56 (of wax impression).

Palaeoneilo victoriae Chapman. P 7915
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern, left valve).
Chapman, F., *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 47.

Palaeoneilo victoriae Chapman. P 7916
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 48.

Palaeoneilo victoriae Chapman. P 7917
Upper Silurian (Melbournian).
Domain Road sewer, South Yarra, Victoria.
Paratype (steinkern, right valve).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 49.

Paleodora reeftonensis Fleming. P 16761-2
Lower Devonian (Reefton mudstone).
Rainy Creek, Reefton, New Zealand.
Plastotypes (holotype P 16761; paratype P 16762).
Fleming, C. A., 1956. *Trans. Roy. Soc. N.Z.* 84 (4): 943.
Fleming, C. A., 1957. *Trans. Roy. Soc. N.Z.* 85 (1): 135-140, Pl. 14, fig. 1-2.

Panenka cingulata Chapman. P 2263
Upper Silurian or Lower Devonian.
McMahon's Creek, Upper Yarra, Victoria.
Holotype (external mould).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 14 (of wax impression).

Panenka gippslandica McCoy. P 7486
Upper Silurian.
Mount Matlock, Victoria.
Holotype (steinkern, both valves).
McCoy, F., 1879. *Prod. Pal. Vict.* Dec. 6, p. 23, Pl. 56, fig. 1, 1*a*.
'Cardium gippslandicum.'
Chapman, F., 1908. *Mem. Nat. Mus.* Melb. 2: 5-62.

Panenka gippslandica McCoy. P 7488
Upper Silurian or Lower Devonian.
Four miles above Starvation Creek, Gippsland, Victoria.
Paratype. P 7487 is associated with this paratype but not figured.
McCoy, F., 1897. *Prod. Pal. Vict.* Dec. 6, p. 23, Pl. 56, fig. 2, 2*a*.
'Cardium gippslandicum.'
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62.

Panenka planicosta Chapman. P 7879
Upper Silurian.
Mount Matlock, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 13.

Paracardium filosum Chapman. P 7881
Upper Silurian or Lower Devonian.
Starvation Creek, Upper Yarra, Victoria.
Holotype (external mould).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 15 (of wax impression).

Paracyclas siluricus Chapman. P 7947
Upper Silurian or Lower Devonian.
Ranges E. of Heathcote, Victoria, G.S.V. B*b* 50.
Holotype.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 85, 85*a*.

Paracyclas siluricus heathcotiensis Chapman. P 988
Upper Silurian or Lower Devonian.
Ranges E. of Heathcote, Victoria, G.S.V. B*b* 50.
Holotype of subspecies (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 86-86*a*.

Parallelodon aequalis Chapman. P 7924
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 57.

? *Parallelodon kilmoriensis* Chapman. P 7925
Upper Silurian.
Police Paddock, Kilmore, Victoria, G.S.V. B*b* 22.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 58.

? *Parallelodon kilmoriensis* Chapman. P 7926
Upper Silurian (Melbournian).
Swanston Street sewer, Melbourne, Victoria.
Paratype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 59.

Parallelodon spryi Chapman. P 7950
Upper Silurian.
Wandong, Victoria.
Holotype.
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 3.

Praelucina ancilla Barrande. P 7882
Yeringian. Upper Silurian or Lower Devonian.
Maindample, near Mansfield, Victoria.
Hypotype (right valve).
Chapman, F., *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 6, fig. 88-88*a* (of wax impression).

Pterinea lineata Goldfuss.
see *Ambonychia tatei* Cresswell.

Pterinea lineata Goldfuss. P 7927
Lower Devonian (Yeringian).
'Croydon, Victoria' = Kilsyth.
Hypotype (steinkern, left valve).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 60.

? *Pterinea tenuistriata* McCoy. P 7928
Upper Silurian (Melbournian).
Yarra Improvement Works, South Yarra, Victoria.
Hypotype (external mould).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 4, fig. 61.

Sphenotus warburtonensis Chapman. P 2240
Upper Silurian or Lower Devonian.
Reefton, near Warburton, Victoria.
Holotype (steinkern).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 1, fig. 10.

Tancrediopsis raricostae Chapman. P 7918
Lower Devonian (Yeringian).
Junction of Woori Yallock Creek and Yarra River, Victoria, G.S.V. B 23.
Holotype (steinkern, left valve).
Chapman, F., 1908. *Mem. Nat. Mus. Melb.* 2: 5-62, Pl. 3, fig. 50.
Palaeoneilo raricostae.
Gill, E. D., 1949. *Mem. Nat. Mus. Melb.* 16: 91-114, Pl. 3, fig. 11.